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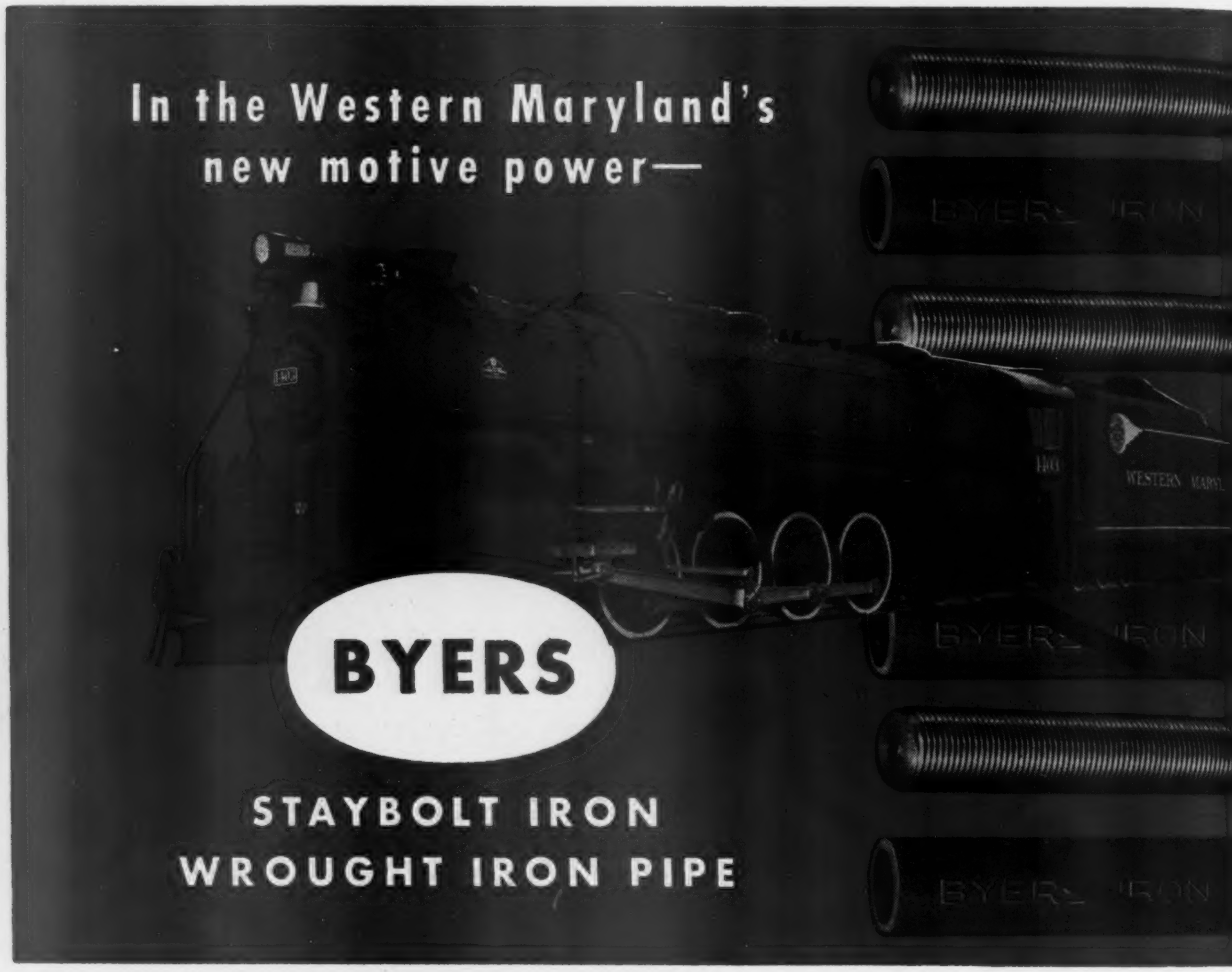

Twelve powerful new 4-8-4's have just been added to the Western Maryland Railway's pool of motive power. Built by Baldwin, the locomotives make extensive use of wrought iron in the services where shock and vibration are threats to service life. Piping, staybolts, drawbars, safety-bars and spring bands are all made of this reliable material. Piping, other than steam, on all of the locomotives, and staybolt material on two of them, are Byers Wrought Iron.

The service conditions that locomotive piping and staybolts must live with are extremely severe. Piping is exposed to excessive vibration, that causes speedy fatigue failure in vulnerable materials. Staybolts must not only stand vibration, but are under heavy varying stress, exposed to elevated temperatures, and subjected to abrasion from cinders in the fire box.

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RAILWAY
MECHANICAL ENGINEER

Great Northern Receives

Streamline Empire Builders

Five twelve-car trains built by Pullman and hauled by twin-unit 4,000-hp. Electro-Motive Diesels with a maximum speed of 92 m.p.h. reduce time between Chicago and the Pacific Northwest

AMERICA's first postwar-built, de luxe, transcontinental streamline train, the "Empire Builder." comprises five 12-car trains which were placed in service on fast daily schedules between Chicago and Seattle on February 23 by the Great Northern and the Chicago, Burlington & Quincy.

Each train consists of a mail-baggage car, a 60-seat coach, three 48-seat coaches, a coffee shop, a diner, four sleepers and an observation-lounge, power being supplied by an Electro-Motive two-unit 4,000-hp. Diesel locomotive geared for a top speed of 92 m. p. h.

Cars for the new seven-million dollar fleet of "Empire Builders" were built by the Pullman-Standard Car Manufacturing Company, Chicago. The trains save 13½ hours over previous schedules and make the 2,211-mile run between Lake Michigan and Puget Sound in 45 hours.

Four of the "Empire Builders" were built by Pullman-Standard for the Great Northern, and the fifth for the Burlington, which operates the trains between Chicago and St. Paul, Minn. Individual cars in the trains are 85 ft. long between coupler pulling faces and have vestibules at one end only, except the baggage, coffee-shop and dining cars which have no vestibule entrances. In general, coaches are coupled with the vestibule ends, in which men's lounge rooms are located, adjoining. Similarly, two non-vestibule ends with women's rooms are placed together for greater convenience in case one room becomes crowded and passengers want to move to the other.

Three coaches on each train, seating 48 passengers, are of the "Day-Nite" design and include the chaise-longue reclining seats. These luxuriously upholstered seats give maximum riding comfort during the day and at night the passenger obtains full-length sleeping comfort by reclining his seat and pulling down a large upholstered leg rest which is built flush into the back of the seat ahead.

Average Weights and Capacities of the "Empire Builder" Cars

Type of car	Plan number	Seating capacity	Sleeping capacity	Journal size, in.	Weight lb.*
Mail-baggage	7494	..	..	6 × 11	112,300
Coach	7495	60	..	5½ × 10	119,500
Coach	7496	48	..	5½ × 10	119,500
Coach	7497	48	..	5½ × 10	119,500
Lounge-lunch-dormitory	7498	20	20†	6 × 11	128,500
Diner	7499	36	..	6 × 11	130,000
Sleeping	4107	..	24	6 × 11	133,200
Sleeping	4108	..	24	6 × 11	137,700
Sleep,-observ,-lounge	4109	27	7	5½ × 10	123,400

* Less water and live load.
† For diner and coffee-shop crews.

Seats in these cars are farther apart than in the ordinary car, giving passengers an opportunity to stretch out fully.

Spacious ladies' lounges are located at one end of each coach with an equally large men's lounge at the other. All cars on the "Empire Builders" are air-conditioned and a master radio set carries programs and announcements to all cars with the exception of the Pullmans. Train and locomotive crews can also communicate with each other over a telephone between the cab and the first coach.

All coaches, including the 60-seat coach, have reclining seats equipped with foot rests—The colors of the native flowers found in the Northwest are expressed in the car interiors

Sleeping Cars

Twenty of the cars, four on each train, are all-sleeper, while five are a combination of sleeping facilities with buffet-lounge-observation ends. All will be operated by The Pullman Company.

Four different types of sleeping accommodations are offered the traveler. Duplex-roomettes, bedrooms and open sections have been built into 10 of the cars with a capacity of 24 passengers. Ten more cars, two to each train, carry 16 Duplex-roomettes and four bedrooms, while the five observation-lounge cars include two bedrooms and a drawing room. The Duplex-roomettes in the "Empire Builders" are the first to be included in a transcontinental train. By an ingenious staggering of this single-occupancy room, to conserve on space, engineers have made it possible for travelers to have private room accommodations at only slightly more than the cost of a lower berth.

Bedrooms on the new trains are the first to have wardrobes at aisle sides for hanging clothes, and in addition to conventional running hot and cold water, are provided with ice-water taps, which eliminate the conventional water bottle.

Ample dining facilities are provided on the new trains, for each carries a full-size conventional diner and a coffee-shop-lounge car. The diners seat 36 persons, while 20 can be accommodated in the coffee shop, 10 at counter stools and 10 in the lounge.

The observation end car, which also includes two bedrooms and a drawing room, will accommodate 27 passengers in the lounge. Furniture is a combination of luxuriously upholstered settees and chairs, with two tables seating four each, set diagonally into alcoves.

Car Construction

All of the new "Empire Builder" cars embody Pullman-Standard welded girder-type construction, utilizing low-alloy, high-strength steel for underframes, sides, ends and roofs and meeting A. A. R. strength requirements. Substantial weight savings without sacrifice of strength have been effected, the average car weights varying from 112,300 lb. for the mail-baggage car to 137,700 lb. for one of the sleepers, as shown in the table. The car body bolsters are built-up, arc-welded, box-section with two web plates and top and bottom cover plates. The buffer beams are built up welded construction. End frames are designed to suit either the wide-type vestibule, dummy end, or rounded observation end, as called for by individual floor plans. Roof construction is of the turtle-back type, continuous from end to end of the car. Draft gears are of the Waugh twin-six type and National tightlock Type-H couplers. Buffers are designed with side stems and coil springs of sufficient capacity to keep buffers in out position.

At all vestibules, Pullman-Standard pivoted four-tread steps are installed on each side of the platform and operated in conjunction with the trap doors. Vestibule diaphragms have center and outer closures and center-stem suspension with a vertical support rod on each side. The face plate is made of wear-resisting alloy steel. Outer diaphragms are of rubber.

The insulation in three of the trains is Stonefelt and in two trains, Fiberglas. This insulation is 3 in. thick in the

Partial List of Materials and Equipment on the New "Empire Builder" Cars

Low-alloy high-tensile steel	Carnegie-Illinois Steel Corp., Pittsburgh, Pa. **Inland Steel Co., Chicago**
Trucks:	
Truck frames	General Steel Castings Corp., Eddystone, Pa.
Roller bearings	Timken Roller Bearing Co., Canton, Ohio
Center pins	W. H. Miner, Inc., Chicago
Springs, side bearings and clasp brakes	American Steel Foundries, Chicago
Wheels	Edgewater Steel Co., Pittsburgh, Pa.
Axles	Carnegie-Illinois Steel Corp., Pittsburgh, Pa.
Shock absorbers	Houde Engineering Div. of Houdaille-Hershey Corp., Detroit, Mich.
Brake shoes	American Brake Shoe Co., New York
Air brakes	New York Air Brake Co., New York
Wheel-slip controller	American Brake Shoe Co., New York
Hand-brakes	National Brake Co., New York
Draft gears	Waugh Equipment Co., New York
Couplers and yokes	National Malleable & Steel Castings Co., Cleveland, Ohio
Insulation:	
Fiberglas (2 trains)	Gustin-Bacon Mfg. Co., Kansas City, Mo.
Stonefelt (3 trains)	Johns-Manville Sales Corp., New York
Floor composition	Tuco Products Corp., New York
Interior Finish:	
Aluminum	Aluminum Co. of America, Pittsburgh, Pa.
Tempered Presdwood	Masonite Corp., Chicago
Aluminum-covered plywood	Haskelite Mfg. Corp., Grand Rapids, Mich.
Steel	American Rolling Mill Co., Middletown, Ohio
Stainless steel for all pantries and kitchens	Allegheny Ludlum Steel Corp., Pittsburgh, Pa. United States Steel Corp., Pittsburgh, Pa.
Monel metal	International Nickel Co., New York
Window sash and fixtures	Adams & Westlake Co., Elkhart, Ind.
Door checks	Norton Lasier Co., Chicago
Polished plate glass:	
Sleepers	Pittsburgh Plate Glass Co., Pittsburgh, Pa.
Other cars	Libbey-Owens-Ford Glass Co., Toledo, Ohio
Prismatic plate glass	Pressed Prism Plate Glass Co., Morgantown, W. Va.
Paint:	
Exterior	E. I. du Pont de Nemours & Co., Wilmington, Del.
Interior	Pittsburgh Plate Glass Co., Pittsburgh, Pa. Sherwin Williams Co., Chicago
Leatherette wall covering, leather stool and diner chair covering	Blanchard Bros. & Lane, Newark, N. J. Goodall Fabrics, Inc., Chicago
Stainless-steel metal trim; metal moldings	Brasco Manufacturing Co., Harvey, Ill. Pyramid Metals Co., Chicago Weirton Steel Co., Weirton, W. Va.
Mirrors and decalcomanias	Cadillac Glass Co., Chicago Meyercord Co., Chicago
Photo murals	Kaufmann Fabry, Chicago
Floor covering—carpets	Beck & Blatchford, Chicago Bigelow Sanford Carpet Co., New York Holmes Archibald & Son, Chicago
Rubber floor covering	Goodyear Tire & Rubber Co., Akron, Ohio
Linens	William Liddell & Co., New York
Silver	International Silver Co., Meridan, Conn.
Chinaware	Onondaga Pottery Co., Syracuse, N. Y.
Glassware	Owens-Illinois Glass Co., Toledo, Ohio
Coach seats	Heywood-Wakefield Co., Gardner, Mass.
Seat covering, coaches	Collins & Aikman Corp., New York
Observation chairs, carpets	Beck & Blatchford, Chicago
Chairs for dining cars	General Fireproofing Co., Youngstown, Ohio
Smoking stands	Precision Metal Workers, Chicago

Card chairs, folding	Clarin Manufacturing Co., Chicago
Venetian blinds	Ajax-Consolidated Co., Chicago
Draperies	Goodall Fabrics, Inc., Chicago
Window curtains	Pantasote Corp. of N. J., New York
Window cappings	Formica Insulation Co., Cincinnati, Ohio
Kitchen and lunchroom dishwashers, Surgex	Stearnes Co., Chicago
Kitchen, pantry, and buffet sinks	Chicago Faucet Co., Chicago
Faucets and drains	Imperial Brass Manufacturing Co., Chicago
Tanks	Chicago Steel Tank Co., Chicago
Air-pressure water tanks	Scaife Co., Oakmont, Pa.
Levelometer	Liquidometer Corp., Long Island City, N. Y.
Pumps	Aurora Pump Co., Aurora, Ill.
Water coolers:	
Ice-type (baggage mail cars)	Henry Giessel Co., Chicago
Electro-mechanical (coaches)	Cordley & Hayes, New York
Electro-mechanical (sleepers)	General Electric Co., Chicago
Washstands	Adams & Westlake Co., Elkhart, Ind.
Water closets—plumbing	Crane Co., Chicago Duner Co., Chicago
Sanitary napkin dispensers	West Disinfecting Co., Long Island City, N. Y.
Fire extinguishers	Pyrene Mfg. Co., Newark, N. J.
Drinking-cup equipment	Logan Drinking Cup Div., U. S. Envelope Co., Worcester, Mass.
Heating equipment and controls	Vapor Car Heating Co., Chicago
Steam trainline	Steel & Tube Div., Republic Steel Corp., Cleveland, Ohio
Emergency hot-water heaters	Vapor Car Heating Co., Chicago
Air-conditioning equipment and refrigerating units	Frigidaire Division, General Motors Corp., Dayton, Ohio Trane Co., La Crosse, Wis.
Indicating lamps on air-conditioning controls	H. R. Kirkland Co., Morristown, N. J.
Air filter	American Air Filter Co., Louisville, Ky.
Air diffusers:	
Sleeping rooms	Anemostat Corp. of America, New York
Other cars	Pyle-National Co., Chicago
Radio and public address	R. C. A. Victor Div., Camden, N. J.
Lighting fixtures	Crouse Hinds Co., Syracuse, N. Y. H. R. Kirkland Co., Morristown, N. J. Luminator, Inc., Chicago Safety Car Heating & Lighting Co., New York
First-aid cabinet	Bauer & Black Div., Kendall Co., Chicago
Batteries	Electric Storage Battery Co., Philadelphia, Pa. Gould Storage Battery Corp., Depew, N. Y.
Battery-charging receptacles	Pyle-National Company, Chicago
Circuit breakers and circulating fans	Westinghouse Electric Corp., Pittsburgh, Pa.
Everdur battery-box floors and hopper tubes	American Brass Co., Waterbury, Conn.
Intake blower fans	B. F. Sturtevant Co., Boston, Mass.
Motor alternator, a.c.-d.c., exhaust fans	Safety Car Heating & Lighting Co., New York
Generators and controls	Safety Car Heating & Lighting Co., New York
Generator drive	Spicer Manufacturing Corp., Toledo, Ohio
Air compressor and other V-belt drives	Dayton Rubber Manufacturing Co., Dayton, Ohio
Headlights and marker lights	Pyle-National Co., Chicago
Tail lights	Mars Signal Light Co., Chicago
Motor-generator converter, sleepers	Janette Manufacturing Co., Chicago

floors, ends and roofs and 2½ in. in the sides to give adequate control of interior car temperatures without excessive demands on air heating or cooling equipment. Double thermopane, shatterproof glass is used throughout all cars.

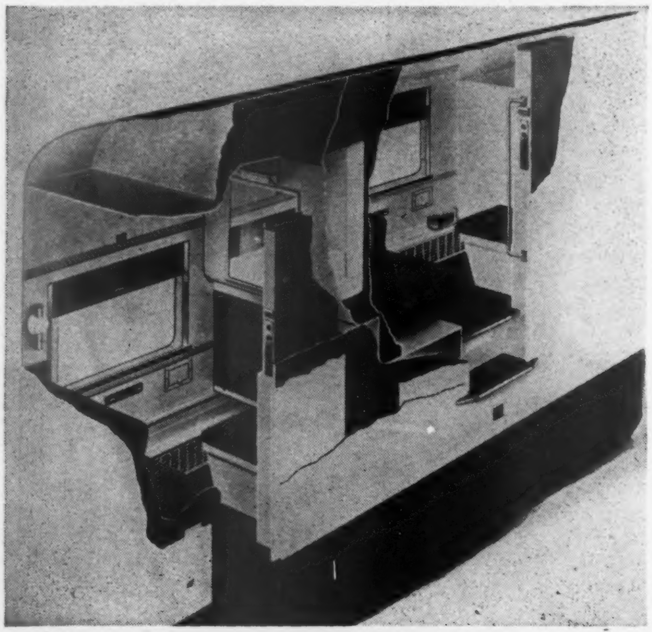
Interior finish consists of Tempered Presdwood for the wainscoting of open sections, passageways and toilet. Aluminum wainscoting is used in all rooms, in the observation lounge, and for pier panels, end finish, and the ceiling in open sections. The ceiling in bedrooms, compartments, and drawing rooms is of Presdwood, except

The exterior coloring consists of alternating broad bands of olive green and deep orange for both beauty and increased visibility

that aluminum is applied where short-radius surface curves require the use of metal. Stainless steel .030 in. thick is shaped to the contour of the carlines in the buffet.

Illumination

In the main seating compartments of the coaches, Luminator individual reading lights are installed in the overhead baggage racks. The single fixture is equipped with two lenses controlled by individual switches, one lens to supply reading light for the passenger on the window side and the other for the aisle passenger. The light beam pattern from the reading lights is designed so as to give the proper intensity at the reading plane of one passenger without overlapping the seat area of any of the passengers adjacent to, ahead of, or behind it.



The Duplex-Roomette, offering private-room accommodations at a cost only slightly above that of a lower berth, is equipped with complete toilet facilities and individual control of heat, light and air conditioning

The coach aisle lighting consists of nine magnifying-lens glass fixtures which project a narrow high-intensity beam of light the width of the aisle without extending into the seating area. This fixture also gives a soft light for the ceiling and upper portion of the car. At night the aisles are illuminated with 10-watt seat-pedestal lights. Vestibule and passageways are lighted with magnifying-lens glass fixtures.

In the lavatories and toilets of the coaches, similar magnifying-lens glass fixtures are also used. The mirror lighting consists of magnifying-lens fixtures at the top of the mirrors. The women's dressing rooms contain large make-up mirrors with side lighting.

In the coffee-shop car the light fixtures are also of the magnifying-lens type.

In the diner, the main dining-room lighting consists of two rows of Safety continuous fluorescent ceiling troughs. Fifteen-watt incandescent night lights are incorporated in these troughs. The lobbies and the passageway of the diner have magnifying-lens incandescent lighting.

In the sleeping cars, main lighting of the passageways and the rooms consists of Safety fluorescent fixtures. The individual berth and reading lights are incandescent fixtures and all lights are equipped with incandescent blue night lights.

The observation lounge is illuminated by a Safety fluorescent trough which is continuous around the entire ceiling, including the curved end at the rear of the room. This fixture is so designed that, in addition to giving direct fluorescent lighting, it also gives indirect illumination to the center of the ceiling. The entire trough is equipped with white incandescent night lights.

Electric Power Supply

Electric power is supplied from a Safety 20-kw. 40-volt Genemotor with a built-in 25-hp. 220-volt a. c. motor which can be plugged in to furnish power for lights and air cooling when cars are at terminals. In normal operation on the road, the Genemotor is driven from one of the car axles by a Spicer Model 6-I gear unit. The motor alternator on each car equipped with fluorescent lights is a Safety two-kw. 32-volt d. c. to 110-volt a. c. machine. A converter is installed in each switchboard locker to supply 110-volt current for electric shavers.

The observation car carries a radio receiver, Pullman antenna, and public address amplifier, with its associated power and control equipment conveniently located in a locker. An eight-conductor shielded trainline and connectors carry the radio receiver and public address announcements through the train. Other electric connections are carried between cars by trainline jumpers with A. A. R. color code wires.

Heating and Air-Conditioning

All cars have the Vapor zone-control heat equipment which maintains temperatures in the various car sections, compartments, rooms and lounges as determined by the setting of individual thermostat controls. Floor heat is supplied from Vapor fin-type radiation units. In the coaches, coffee-shop and dining cars Vapor automatic control panels are used. In the sleepers the control panels are Vapor selective type. The main steam trainline is Electrunite drawn-steel tubing, of 2⅞ in. outside diameter, with welded joints. Baker heaters with an auxiliary heating system are installed in the baggage car and all coaches for emergency heating.

The air-conditioning equipment is of the electro-mechanical type of eight tons capacity, using Freon F-12 refrigerant. It includes a Frigidaire compressor-motor unit with Frigidaire controls and evaporator, and a Trane evaporative condenser. Provision is made for a deodorizer in the recirculating air chamber of the Dorex G-3 type. Air ducts from the overhead unit along the ceiling center line include aluminum and Presdwood construction using parts of the car interior wherever practicable. Air outlets in all sleeping rooms are of the Anemostat diffuser type. In the coaches, coffee-shop, diner and observation cars the underside of the air duct consists of Pyle-National Multi-vent perforated air-diffuser panels, hinged for cleaning. Filters are of the Midwest demountable type.

The General Steel Castings trucks are equipped with Timken roller bearings, shock absorbers and wheel-slip controllers

(*Continued on page 235*)

A Critical Survey of

Diesel Locomotive Design

By H. Bleibtreu*

The author emphasizes the importance of larger power concentration in the locomotive chassis — He proposes variations from present designs and compares the swivel-truck chassis with the rigid type

IT would be premature to take the oft-predicted Dieselization of all railroads for granted. When many years ago, the electric locomotive was hailed as the motive power of the future, the steam locomotive survived, much improved. Now again, it shows a remarkable vitality, which should not be taken lightly. It seems, therefore, advisable to be on the alert and to appraise soberly the present status of Diesel locomotive design. In doing so, let use be guided by certain pertinent facts about the three main organs—the power plant, the chassis, and the transmission.

Power Plant

If we refer to the Diesel locomotives with direct drives, which will be discussed at the end of this article, the Diesel engine set is an independent and self-contained organ, which together with its auxiliaries, such as the radiators, determine the overall length of the chassis. But since the latter is limited by the chosen wheel arrangement and the track curves, the installed horsepower capacity that can be packed into the chassis is also limited.

The largest horsepower capacity per single chassis or unit attained so far in American Diesel-locomotive practice is 2,000 hp. Only in a recent articulated locomotive has it reached 3,000 hp. Non-articulated steam locomotives, however, go as high as 6,000 hp., while the articulated type approaches the 8,000-hp. mark. Measured by the steam locomotive, which still sets the standard, and also by the electric locomotive, the power concentration of the Diesel locomotive unit is entirely too small.

Against this statement the argument has been advanced that by remote or multiple control a number of single units may be joined as a team of any desired capacity, and that for this reason units of only 2,000 hp. or even less are not so bad after all. The railroad man, however, will always strive for as much power concentration as possible. The team is actually an expedient rather than a virtue. While a so-called locomotive consisting of two units may have, under certain conditions, the advantage of good operational flexibility, three and more units per team are, again with exceptions, not very desirable. They take much yard space, but mainly a multiplicity of parts means higher first costs and more maintenance work.

Larger power concentration in connection with fewer parts is, therefore, the most urgent problem that confronts the designer today. Two ways offer themselves: first, the increase of horsepower output per running foot of overall length taken up by the Diesel engines and, second, smaller longitudinal space requirements of the auxiliaries.

* Consulting engineer, Hinsdale, Ill.

It is a wide-spread belief that the two-cycle engine, with twice the number of power strokes, must also have twice the power concentration of the four-cycle engine. Actually, however, this advantage is more or less offset; first, by the introduction of the *Buchi* or equivalent superchargers on four-cycle engines with which the mean effective piston pressure has been increased to range from 105 to 120 lb. per sq. in., while two-cycle engines seldom exceed 80 to 95 lb. per sq. in. (see column *h* of the table); and, second, because the cylinder diameters of modern four-cycle locomotive engines go as high as 13½ in., while two-cycle engines have not as yet exceeded 9 in. (see column *e* of the table). The result is that two-cycle engines must have more and smaller cylinders than four-cycle engines of the same output, so that there is not much difference in the overall length. See column *i* of the table.

Things may turn once more in favor of the two-cycle engine by the application of higher supercharges. Cadenacy has tried to introduce a principle, which is similar to what Buchi did for four-cycle engines, and which consists in the application of pressure pulsations in the exhaust. The Swiss Sulzer Company, on the other hand, has built a two-cycle engine with eight 7-in. by 9-in. cylinders and with a piston-type supercharger which boosts the mean effective pressure to 192 lb. per sq. in. and the one-hour output to 2,700 hp., both values being about twice as high as with ordinary engines.

Incidentally, higher supercharges result also in an increase of the exhaust-gas energy. It has been suggested that an exhaust-gas turbine be installed which would furnish the useful power, while the Diesel engine would act as the pressure combustion chamber for the turbine and would at the same time be mainly restricted to the production of power for its own supercharger. In

Basic Data for Several Representative Diesel Engines and Locomotives

	a	b	c	d	e	f	g	h	i
Engine	No. of cycles	Rated brake hp.	Engine type	No. of cylinders	Piston diameter and stroke, in.	R. p.m.	Piston speeds, ft. per min.	Mean effective piston pressure, lb. per sq. in.	Approximate overall length of Diesel generator set, ft.
A	4	1,000	Straight in line	6	12½ x 13	750	1,635	110	18
B	2	1,100	V-type	2 x 6	8½ x 10	800	1,330	80	15
C	4	1,500	Straight in line	8	12¾ x 15½	625	1,615	120	19
D	2	1,470	V-type	2 x 8	8½ x 10	800	1,330	80	18
E	4	2,000	Twin straight in line	2 x 6	12.2 x 15.4	700	1,795	105	23
F	2	2,000	Opposed piston	10 (20 pistons)	8⅛ x 10	810	1,350	95	20
G	4	2,000	V-type	2 x 8	....	..	....	..	..

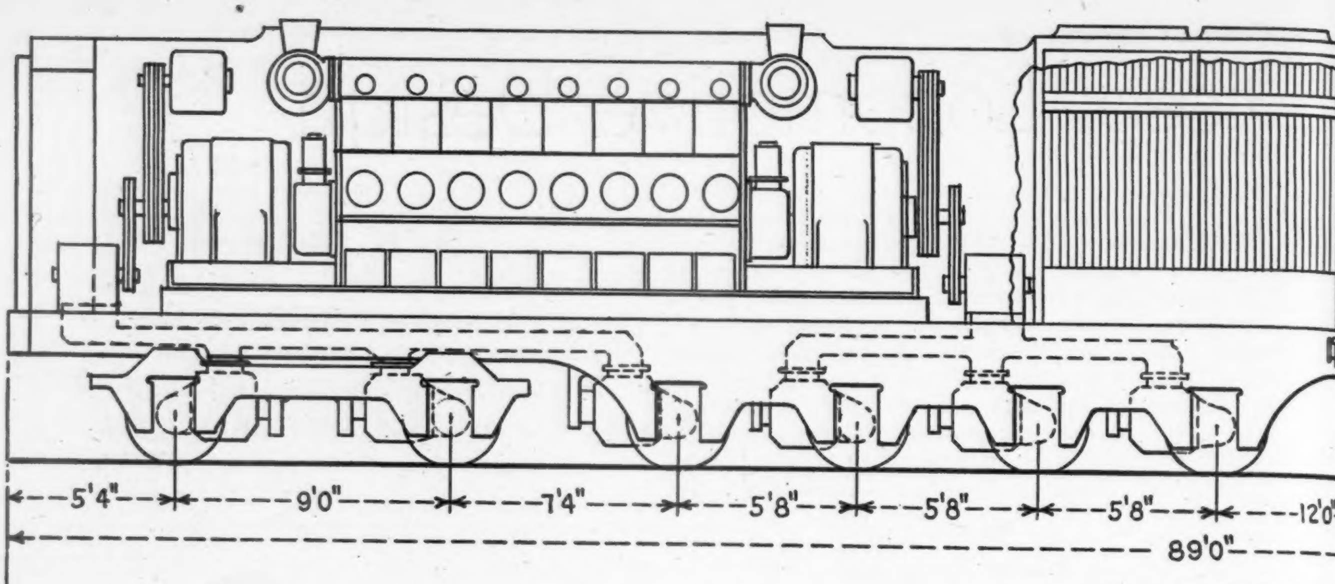


Fig. 1—Proposed 5,340-hp. 4

this manner Diesel engine and gas turbine may be merged into a single prime mover with considerable power concentration.

It does not take these or similar speculations, however, to show that even with the present status of Diesel-engine design higher power concentrations could be obtained. Three examples may suffice:

1—Engine *E* of the table consists virtually of two six-cylinder supercharged four-cycle engines of 1,000 hp. each placed side by side over a common crankcase and bedplate. Experience with this and similar twin engines on European locomotives has shown that this arrangement provides for sufficient accessibility. Where, instead of side-frame members, a chassis with a center sill is to be used, it may also be possible to move the engines close to the outer walls of the cab, with a walkway between. Accessibility could be obtained as in switchers by doors, or by roller curtains in the cab sides. In case of the first mentioned twin arrangement, either a single generator or two independent generators may be used, one ahead, and the other astern of the engines. Now if two rows of eight cylinders each were installed instead of two rows of six cylinders 2,670 hp. could be obtained. Diesel-generator sets of this kind could be accommodated in a comparatively short chassis of the well-known 4-8-4 type, in which four, six or all eight axles could be motorized. In the last case two such units would constitute a freight locomotive of 5,340 hp. In cases where the permissible average axle load is as high as 63,000 lb. the alternate shown by Fig. 1 may be in order. If instead, two engines made by an American builder could be placed side by side (*c* of the table), even 3,000 hp. would be obtainable in a single chassis of the 4-8-4 wheel arrangement.

2—Another American builder now installs in his locomotives a supercharged four-cycle V-type engine, having two rows of eight cylinders each, developing 2,000 hp. If, instead, two rows of 10 cylinders each were installed 2,500 hp. would be obtainable. The result would be not only a shorter chassis than that used in the conventional 2,000-hp. locomotive with its two 1,000-hp. Diesel-generator sets in tandem arrangement but the gain of 500 hp. per unit would be welcome inasmuch as the present two-unit locomotive is not quite strong enough to handle as heavy a train as modern 4-8-4 steam locomotives.

3—A third American builder installs in his locomotives two-cycle engines with either eight or ten cylinders of the Junkers or opposed piston type, developing 1,500 and 2,000 hp., respectively (engine *F* of the table). Here again it seems entirely possible to install two engines of this type side by side over a common crankcase, thereby obtaining 3,000 hp. and, if the wheel loads would permit, even 4,000 hp. per single chassis. Fig. 2 shows the possibilities.

While comparatively small cylinders continue to be desirable where locomotives, such as certain switchers, operate far away from repair shops, the general tendency must be towards larger and fewer cylinders. With steadily increasing reliability, repairs en route should become just as unnecessary as they are unthinkable in the case of steam locomotives.

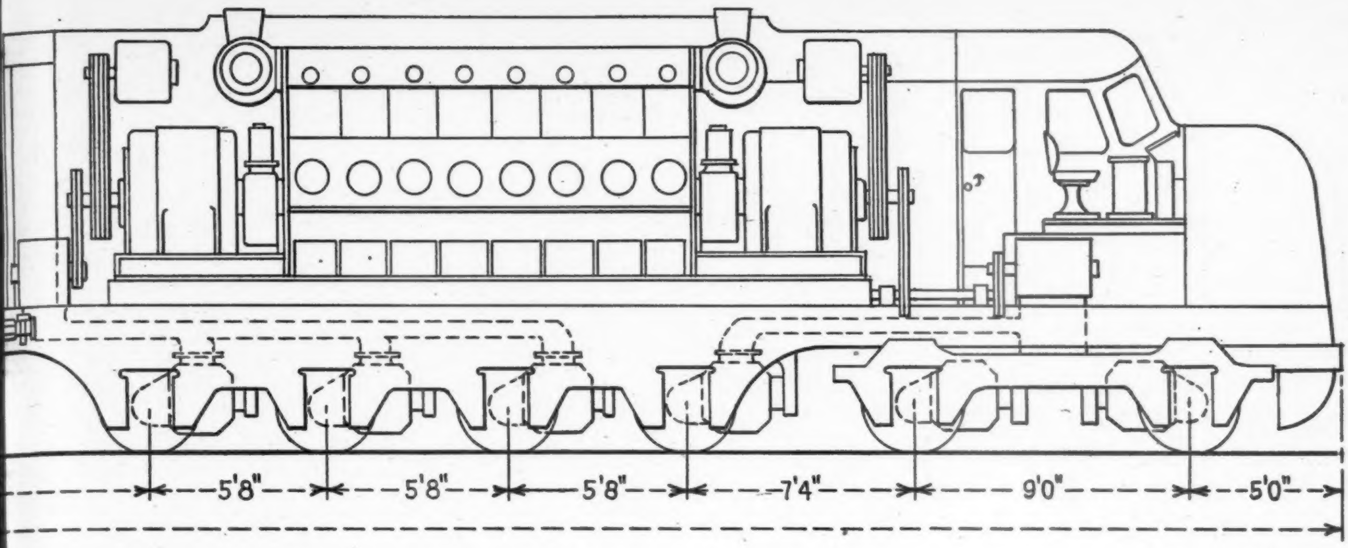
Auxiliaries

Turning now to auxiliaries, the space requirements of the radiators must be decreased. One way, which is used in many of the conventional designs, is to arrange the radiator elements in a hatch under the roof above the engines. Economical as this may be from the standpoint of space, it has the weakness that the cramped air ducts offer high flow resistance, and that the engine cannot be lifted out of the cab without prior removal of the radiator assembly. A better way is the installation of the radiators in the cab sides or in the roof before or behind the Diesel-generator set. Then short well-streamlined air ducts and efficient propeller-type suction fans can be used, high air velocities and correspondingly small radiator elements may be employed without causing excessive power consumption of the fans. Installation of the elements in the side walls and under the roof, as shown by Fig. 2, would add to the compactness.

In contrast to power concentration and fewer parts, weight saving has become a less important problem. Engine weights of 25 to 30 lb. per hp. are now quite common and further weight savings are hardly necessary. In switchers ballast must often be added. In road locomotives eventual savings ought to be sought in water or fuel tanks, which could be made of light metals, or by using fabricated rather than cast-steel swivel-truck frames.

Chassis

Most of the present Diesel locomotives are either of the swivel-truck type, which has been adopted from motor rail cars, or of the so-called rigid type, which has



+8-4 Diesel-electric locomotive

been adapted from the steam locomotive. As the preference for one or the other type is a matter of tradition rather than of sound reasoning, it seems advisable to compare both in regard to the requirements which they must fulfill.

a—Horsepower Capacity that Can Be Installed. Swivel-truck locomotives may be as long as 85 ft. without causing excessive curve resistance, while the rigid type must not be more than 60 to 65 ft. From this it has been concluded that the swivel-truck chassis can also accommodate larger installed hp. capacities. This, however, holds true only for the conventional 2,000-hp. unit with two 1,000-hp. C-type Diesel engines which, due to their overall width, can be installed only in tandem, for which a rigid type chassis is not long enough. Otherwise, particularly in case of the above-stated engine assemblies, the horsepower capacity of the chassis with two conventional three-axle swivel trucks is more limited than that of the rigid type chassis. This can be readily seen if we assume an average unit weight of the locomotive of 150 lb. per hp. and an average weight per axle of 55,000 lb. The maximum horsepower capacity of a swivel-truck chassis would then be $6 \times 55{,}000/150 = 2{,}200$ hp. A rigid-type chassis of the 4-8-4 wheel arrangement can accommodate $8 \times 55{,}000/150 = 2{,}900$ hp. Actually the difference is still larger, since the unit weight of rigid-type locomotives is probably from 5 to 10 per cent smaller than that of equivalent swivel-truck units.

Another limitation of the conventional swivel truck unit is that it cannot have more than four traction motors, against six or even eight in a 4-8-4 chassis. It is true that all three axles of swivel trucks could be motorized. But it would then be necessary to forego spring-suspended truck bolsters as they would interfere with the traction motor of the middle axle, or the middle axle would have to be moved backwards and, instead of the conventional truck bolster suspension, longitudinal leaf springs on the outside of the trucks must be used. It is also true that

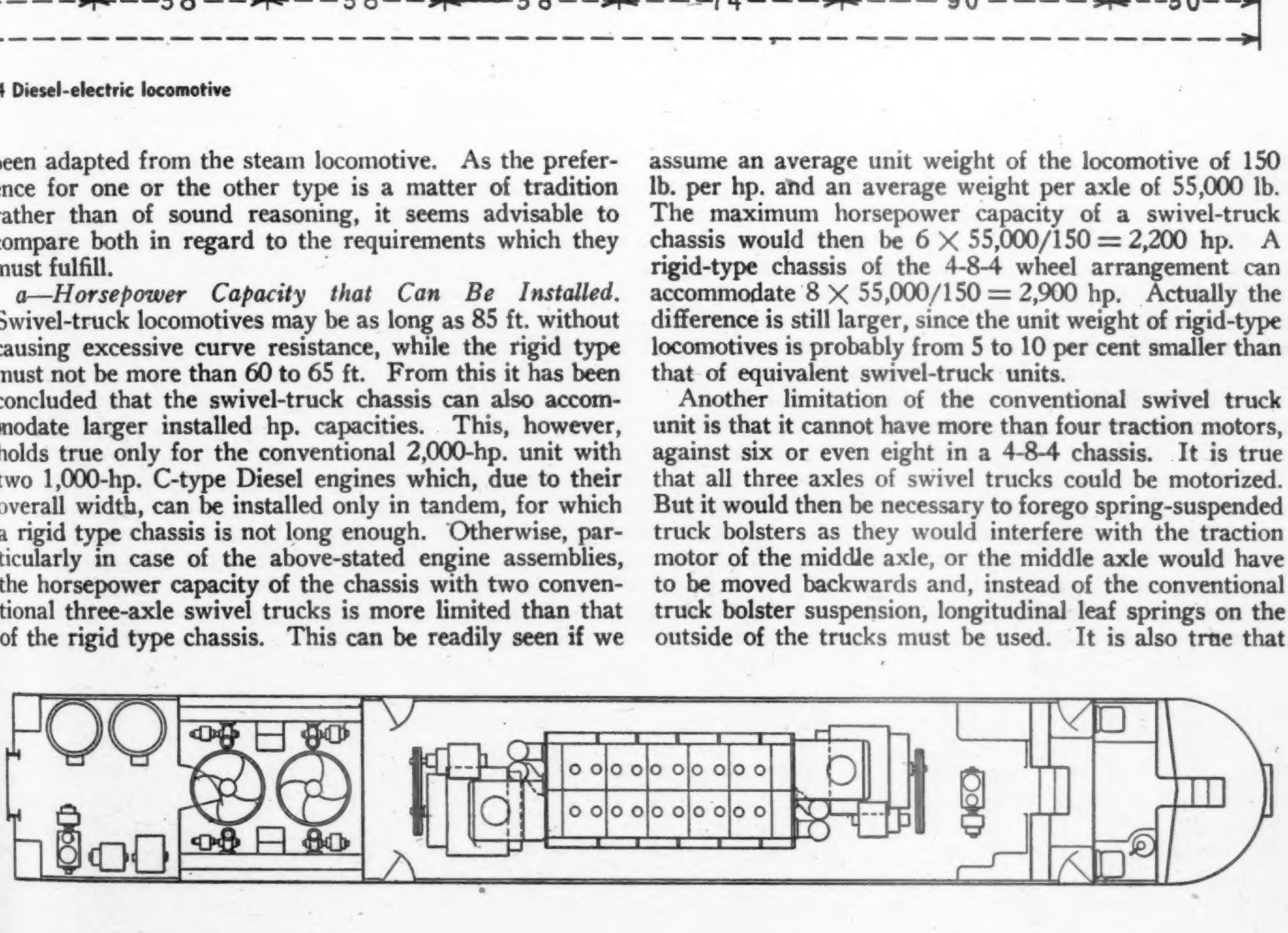


Fig. 2—Proposed 3,000 Diesel-electric passenger locomotive with two adjacent junkers opposed piston-type 10-cylinder Diesels and twin-type traction motors

instead of three-axle trucks four-axle trucks could be employed. But then only three axles could be motorized, as the traction motor of the outmost axle is apt to interfere with the draft arms of the coupler. It seems better to consider trucks with twin motors as shown in Fig. 2. Twin motors are used in many electric locomotives and in at least one large Diesel-electric locomotive. They could be mounted in a frame so that individual motors can be swung out of mesh in case of motor or gear trouble. The quill drive of twin motors can hardly be considered a drawback as we will come to it eventually on any high speed locomotive in order to reduce the unsprung axle loads.

b—Curve Resistance. For switchers which must negotiate curves of 100-ft. radius and even less the swivel-truck type is the only solution. The same may hold true for roads with many sharp curves. Yet there are many steam and electric locomotives of the 4-8-4 type with rigid driving-wheel bases of 16 ft. which are able to negotiate curves of 350-ft. radius without excessive flange and rail wear.

c—Riding Qualities. Rigid-type locomotives with conventional spring equalizers have entirely satisfactory riding qualities even at high speeds. On the other hand, the much-praised soft springing of swivel-truck locomotives is not very important, as it is in the case of rail cars. Furthermore, soft springs require low centers of gravity unless cross stabilizers are used. Low centers of gravity are difficult to attain unless solid bed plates for the Diesel generator set are omitted. They are not any more desirable than in steam and electric locomotives, both of which are given relatively high centers of gravity in order to avoid hard side thrusts in curves.

d—Weight Distribution. Faulty axle-load distribution due to removal or addition of heavy parts such as heating boilers can be corrected by simple changes of the equalizer leverage of the rigid type chassis, while in swivel-truck locomotives ballast weights must be added.

e—Replacement of Traction Motors. Swivel trucks can be moved out from underneath the chassis with little jacking, thereby facilitating repair work, while motors and wheel sets of rigid wheel bases can be removed only by dropping them over the inspection pit.

f—Safety. The underframes of the rigid type have the advantage of greater resistance against buckling in case of collisions. Owing to their pedestals they are also less apt to plow deep into the rear car as swivel-truck locomotives if they leave the front truck behind, as in the Naperville wreck. On the other hand, the rigid type has the weakness that the fuel tanks are mounted over the floor line, where they endanger the crew much more than if they were underneath the frame, as in swivel-truck locomotives. It would be possible, however, to place the fuel tanks along the outside of the outer frame members of the rigid type chassis in such a way that the accessibility to the journal boxes and brake rigging will not be impaired.

g—First Costs and Weights. Rigid-type locomotives are lighter and somewhat cheaper, because the cab does not have to be a self-supporting structure with bridge type side walls.

Transmission

The basic law of traction dynamics requires a torque at the drivers which is highest at the start and which declines gradually along the well-known torque-speed hyperbola, thereby maintaining the full horsepower output over a wide speed range. The steam locomotive fulfills this law almost ideally. The Diesel engine, however, has a constant torque characteristic, which can be reconciled with the decreasing torque requirement of the basic traction law only conditionally. Either a transmission with a variable speed ratio must be inserted between the Diesel engine and the drivers, or, in case of the direct drive, a device that boosts the Diesel engine torque at the start and at low train speeds must be employed.

Transmissions with variable speed ratios can be:

1—*Mechanical as in Automobiles.* As the speed ratio changes step-wise, the Diesel engine reaches its full output only at the end of each step. This and the time loss during gear shifts restrict mechanical transmissions to rail cars and small locomotives.

2—*Pneumatic.* A Diesel-compressor set furnishes air or combustion gases to the working cylinders. In several cases, steam locomotives have been converted, the Diesel-compressor taking the place of the boiler. While fair efficiencies were obtained, intercooling and reheating of air or waste gases involve certain complications.

3—*Hydraulic of the Piston Displacement Type.* Small switchers, equipped with this drive, showed excessive oil leakages, low transmission efficiencies and closely limited power ratings.

4—*Hydraulic of the Flow Type.* The Diesel engine drives two centrifugal pump impellers, each of them being inclosed in a housing, which contains suitable vanes and a water turbine wheel. The first set acts as a torque converter for the lower, and the second set works as a hydraulic clutch for the upper speed range of the locomotive. Quite a few high speed rail cars and several locomotives, one being a 1,400-hp. unit, have been operating successfully with this transmission.

5—*Electrical.* Today, only transmissions (4) and (5) are of practical importance. The electrical transmission has the undisputed advantage of ease of control, unsurpassed freedom of motorization of individual axles, and absence of reciprocating masses. By the newer methods of load control the ideal torque-speed hyperbola can be approached, so that the Diesel engine can operate at full load at any train speed, while at fractional loads the engine

(*Continued on page 235*)

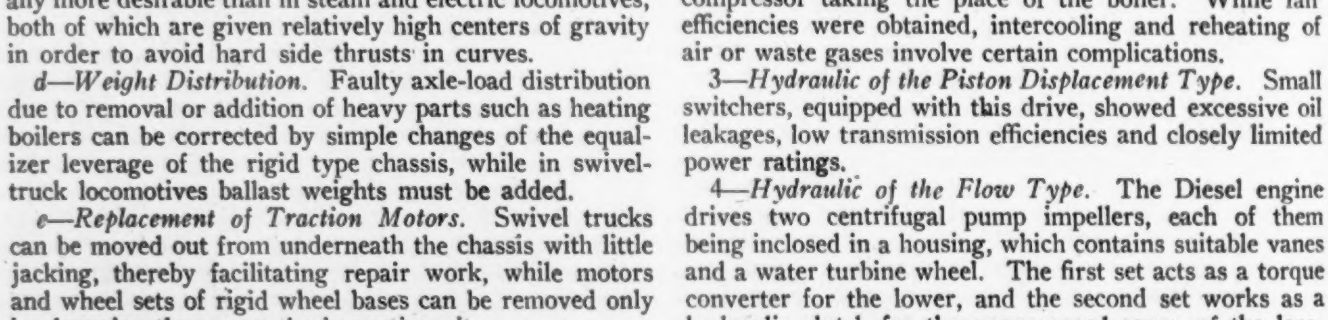


Fig. 3—Proposed 4-8-4 2,700-hp. Diesel-hydraulic passenger locomotive

70-Ton Covered Hopper Cars

The New York Central received delivery last fall of 750 covered hopper cars of 70-ton capacity from the Despatch Shops, Inc., East Rochester, N. Y. While essentially of the same general construction as one lot of 200 built in 1939 and one lot of 500 built in 1940, the new cars, designed by the railroad, include improvements over the previous lots, some of which were based on the results of a canvass made of on-line shippers of cement, soda ash and other bulk commodities requiring protection from unfavorable weather conditions.

Although built of carbon steel the hopper cars are 2,600 lb. lighter, have 200 cu. ft. more capacity and eight roof hatches, two less than the 700 cars of earlier design. The greater capacity is made possible by the increase in length of 2 ft. 10 in. and in height of two inches. The outside of the hopper discharge openings are flush with the inside faces of the rails, a design that avoids the need for deflector boots when unloading the cars. The cars have a center bulkhead that divides the body into two compartments which may be loaded or unloaded separately or simultaneously. The hoppers are built with a 50-deg. slope and are furnished with vibrator brackets, both features contributing to the unloading speed. Inside ladders have been installed to facilitate the cleaning of the car interiors.

The general character of the structure is shown in the cross section and the sectional plan and elevation.

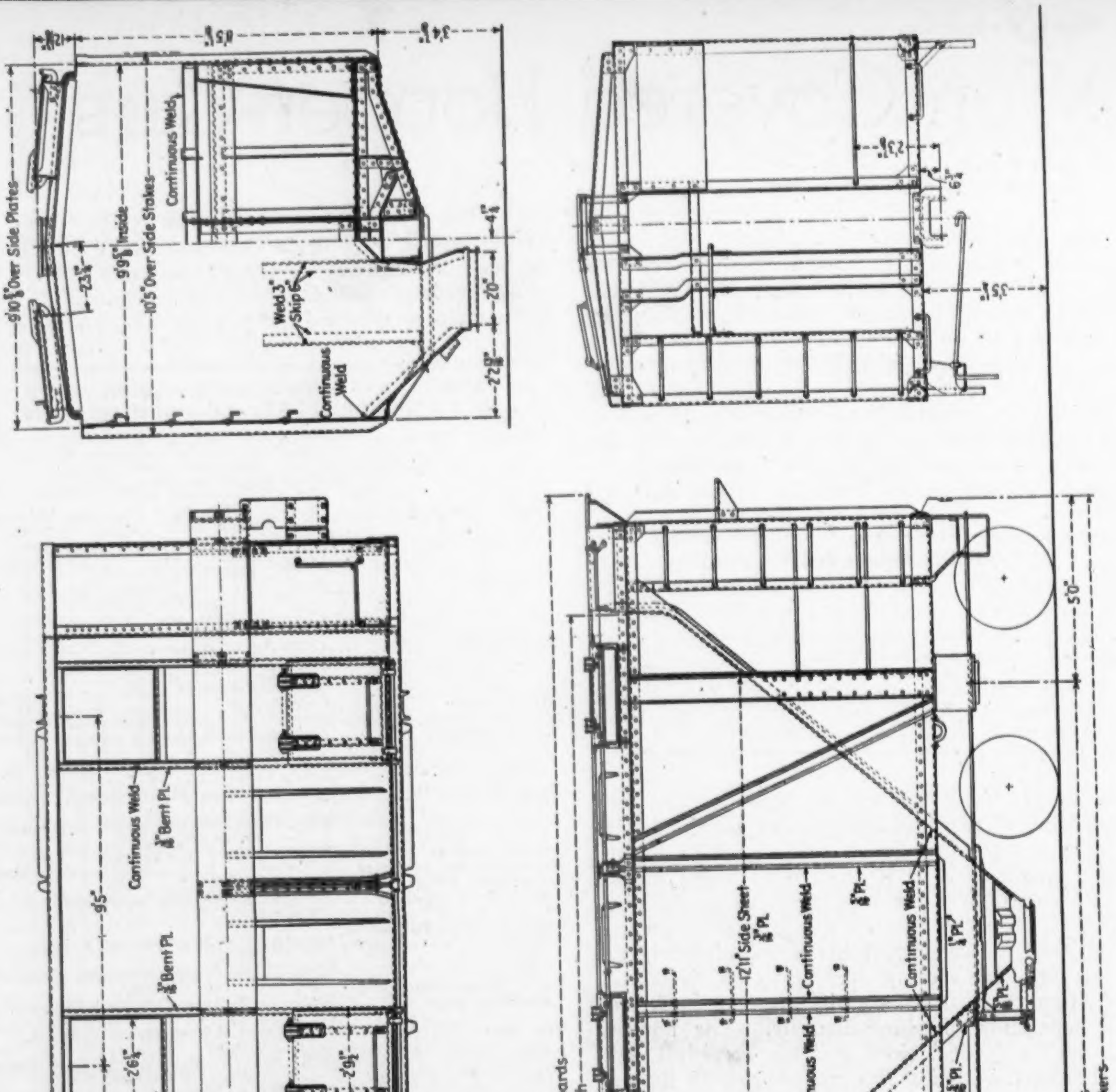
Principal Dimensions and Weights

Length over strikers, ft.-in.	35— 1⅝
Length inside body, ft.-in.	29— 3
Width over side plate, ft.-in.	9—10⅝
Width over side stakes, ft.-in.	10— 5
Width inside, ft.-in.	9— 9⅝
Height rail to bottom of discharge outlet, ft.-in.	0— 9
Distance center to center of trucks, ft.-in.	25— 1⅝
Truck wheel base, ft.-in.	5— 8
Capacity, cu. ft.	2,000
Nominal capacity, lb.	140,000
Light weight, average, lb.	51,600

Partial List of Material and Equipment on the New York Central 70-Ton Covered Hopper Cars

Truck side frames	(200) American Steel Foundries, Chicago
	(250) Buckeye Steel Castings Company, Columbus, Ohio
	(300) Pittsburgh Steel Foundry Company, Pittsburgh, Pa.
Truck bolsters	(200) American Steel Foundries, Chicago
	(250) Buckeye Steel Castings Company, Columbus, Ohio
	(300) Pittsburgh Steel Foundry Company, Pittsburgh, Pa.
Truck side bearing	(375) Atlas Steel Castings Company, Irvington, N. J.
	(375) Pittsburgh Steel Foundry Company, Pittsburgh, Pa.
Truck springs	(300) American Locomotive Company, New York
	(450) Crucible Steel Company of America, New York
Spring plates	Crucible Steel Company of America, New York
Stabilizer, Barber, Type S-2	Standard Car Truck Company, Chicago
Wheels, one-wear	(300) Bethlehem Steel Company, Bethlehem, Pa.
	(450) Carnegie-Illinois Steel Corporation, Pittsburgh, Pa.
Axles, 6 in. x 11 in.	(300) Bethlehem Steel Company, Bethlehem, Pa.
	(450) Carnegie-Illinois Steel Corporation, Pittsburgh, Pa.
Journal bearings	Magnus Metal Corporation, New York
Journal-box lids with pins	Motor Wheel Corporation, Lansing, Mich.
Roofs, hatch carline, and hatch frame assembly	Standard Railway Equipment Company, Chicago
Running boards and brake steps	(250) Apex Railway Products Company, Chicago
	(500) U. S. Gypsum Company, Chicago
Bottom doors, frames, and discharge gates	Enterprise Railway Equipment Company, Chicago
Draft gear	(250) Cardwell-Westinghouse Company, Chicago
	(250) National Malleable & Steel Castings Company, Cleveland, Ohio
	(250) Waugh Equipment Company, New York

A center bulkhead divides the covered hopper cars into two compartments that may be loaded separately or simultaneously



The plan, elevation and cross-sections showing the construction of the New York Central's 70-ton covered hopper cars

Swiveling yokes, cast-steel	(200) American Steel Foundries, Chicago (375) National Malleable & Steel Castings Company, Cleveland, Ohio (175) Symington-Gould Corporation, Rochester, N. Y.
Swivel coupler, cast-steel	(375) National Malleable & Steel Castings Company, Cleveland, Ohio (375) Symington-Gould Corporation, Rochester, N. Y.
Centering devices	Standard Railway Equipment Company, Chicago
Release rigging	Standard Railway Equipment Company, Chicago
Air brakes	New York Air Brake Company, Watertown, N. Y.
Hand brakes	(350) Union Asbestos & Rubber Company, Chicago (400) Universal Railway Devices Company, Chicago
Brake shoes	American Brake Shoe Company, New York
Brake beams	Buffalo Brake Beam Company, New York
Brake hanger wear plates	Illinois Railway Equipment Company, Chicago
Brake beam supports	Chicago Railway Equipment Company, Chicago
Defect card holders	Apex Railway Equipment Company, Chicago

Great Northern—Empire Builders

(*Continued from page 228*)

The trucks have an 8-ft. 6-in. wheel base and are of the four-wheel, single-bolster type with integral cast-truck frames of alloy steel, made by the General Steel Castings Corporation. The 36-in. steel wheels are mounted on normalized and tempered axles with either 5½ in. by 10-in., or 6-in. by 11-in. journals and Timken roller bearings. Rubber-insulated bolster anchors are installed, eliminating the need for transom or bolster wear plates. Drews spring-type side bearings and Miner 4-in. three-piece safety center pins are used. The trucks are equipped with A. S. F. unit-cylinder clasp brakes, having two brake cylinders per truck, automatic slack adjusters and an anti-rattling device in the brake rigging.

Air-brake equipment consists of the New York H. S. C. schedule with D-22 BR control valve, electro-pneumatic straight-air control and speed-control governor. The American Brake Shoe Controller, which prevents wheel sliding, is driven from a spline bushing on the end of the axle. All cars except the observation car have air-controlled sanding equipment to operate in conjunctive with the controller. A vacuum cleaning connection box is supplied on each side of the car, accessible through the skirt. Hand brakes are of the National Brake Company's wheel type in the cars with vestibules and National Peacock pump-type on the cars without a vestibule. Provision is made at the observation end for back-up equipment, including an operating valve, warning horn and air gage in a small locker just above the floor level where it is normally concealed but readily available for use when needed. A red oscillating Mars light on the rear of the train is automatically activated when the train speed falls below a predetermined minimum.

Diesel Locomotive Design

(*Continued from page 232*)

speed can be reduced, thereby saving fuel. Disadvantages of the electric drive are high weights and high costs of the electric machinery, transmission efficiencies of not more than 80 to 85 per cent, and excessive traction-motor temperatures on long and heavy grades. Improvements that may soon be expected are, first, traction motors with more efficient cooling, higher horsepower ratings, higher revolutions and lighter weights and, second, generators which allow a more general use of straight parallel motor operation, thereby eliminating the series-parallel transition, so that a generator can also feed an uneven number of motors.

The hydraulic flow-type transmission, on the other hand, has the advantage of lower weights, lower first costs and higher efficiencies in the upper train-speed range. Like electric transmission the hydraulic drive permits dynamic braking. A disadvantage are the low efficiencies at low train speeds.

Fig. 3 shows a study with two independent 1,350-hp. eight-cylinder four-cycle supercharged engines in side-by-side position. Each engine is coupled by an overdrive to a torque converter and a clutch, the left engine driving the first and the third axle, the other engine the two other axles. There are no reciprocating masses. The drive includes a constant-mesh reversing spur gear, transmission shafts with universal joints, hypoid bevel gears and the well-known axle quill drives.

The direct drive has always appealed to the railroader, as it resembles that of the steam locomotive. In the case of a 1,000-hp. 4-4-4 passenger locomotive, which has been operating in Europe on local runs with fair success for quite a while, boosting of the Diesel cylinders is effected by compressed air to which fuel oil has been added. The mixture is ignited by electric glow bulbs. It burns without pressure increase, thereby producing a full indicator diagram, which resembles that of the steam locomotive at the time of long cutoffs. Remote as the possibilities of the direct drive may appear at the present, they should not be discarded as altogether impractical.

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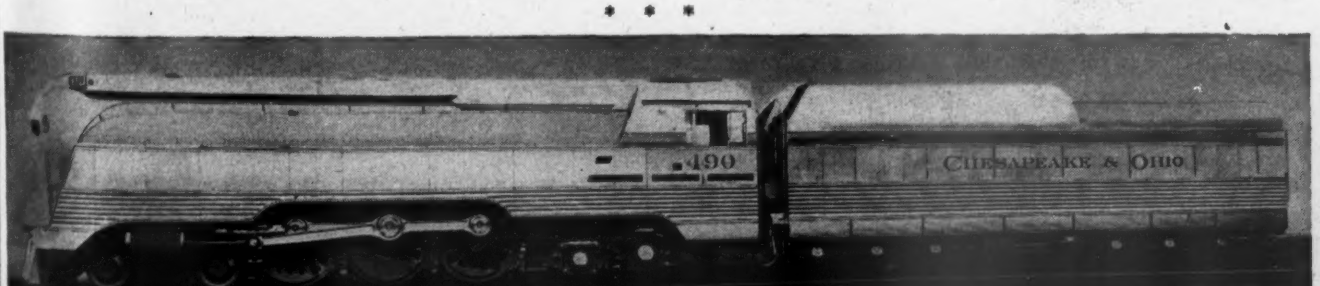

One of five coal-burning locomotives being rebuilt in the shops of the Chesapeake & Ohio at Huntington, W. Va. These locomotives will supplement three steam-turbine-electric units under construction at the Baldwin Locomotive Works which will be used to pull the new "Chessie" streamliners also under construction

The locomotive illustrated; completed after five months' work, was converted from engine No. 490, in service since 1926. It will retain the number 490. For a number of years it pulled the "George Washington" between Cincinnati, Ohio, and Washington, D. C. The original locomotive had a 4-6-2 wheel arrangement. The streamline version is a 4-6-4. Only the tender and a part of the boiler of the old 490 were used in its reconstruction. The tender was rebuilt extensively and, like the engine, sheathed in stainless steel. By using the old boiler, the cost of the engine was reduced by about $17,000, it was estimated. The firebox and smokebox are new. Engine and tender have a combined weight of 372 tons. The principal departure from the mechanical design of the old 490 is the use of poppet valves. The new engine also is equipped with roller-bearing driving wheels, roller bearing rods and a high-speed booster.

Quantity Production of

Welded Passenger Cars*

By A. M. Unger†

The resistance-welding set-up of the Pullman-Standard Car Manufacturing Company for the fabrication of passenger cars

Due to the increased demand for railroad passenger cars, the Pullman-Standard Car Manufacturing Company has installed an enlarged resistance welding set-up for producing cars in quantity production. Roofs and sides for the cars are being made in large spot-welding fixtures that handle full-sized, car-length sections. Subassemblies of stiffeners to side sheets for the cars are being made on a multiple electrode machine with a large table that automatically indexes the work under a row of spot-welding electrodes. These enormous jigs insure correct alignment and a minimum amount of distortion in addition to an accelerated speed of production. Each of these machines will be described in detail. They are all made as fully automatic as possible thereby giving high-quality results with a minimum of labor-costs.

Roof Machine

Roofs for the railroad passenger cars are welded in the machine and jigs shown in Fig. 1. This machine has roller-type electrodes that are mounted on a carriage that traverses the entire length and width of the roof jig. The track for the transverse movement across the roof is shaped to conform with the curvature of the roof so that welding pressure in all positions is normal to the roof.

* Paper presented before a session of the Railroad Division on November 18, 1946, during the annual meeting of the American Welding Society at the Ambassador Hotel, Atlantic City, N. J.

† Welding engineer, Pullman-Standard Car Manufacturing Company, Chicago.

Two electrode rolls are used side by side connected in series with the welding transformer so as to make two welds simultaneously, one on each of two sheets that butt together on the roof carline. The roof carline is supported by a copper back-up bar, which in turn is supported by a steel structure capable of withstanding the pressure of the two welding rolls.

Fig. 2 is a sketch illustrating the path of welding current through the electrode rolls, work and copper back-up bar. As the rolls move along the carline, current is applied intermittently so that a definite spacing of spot welds is produced. A cotton string is placed in between the edges of the two sheets to serve as insulation and prevent the welding current from shunting across from sheet to sheet.

The movement of the welding rolls along the carline

Fig. 1—Spot welding the roof sheets to the carlines using roller-type electrodes

is controlled by a variable-speed, d.c. motor driving the welding unit. The welding rolls are idlers, their speed being governed by the speed of the welding unit. This is a direct ratio only when the welding unit is running on a straight track and the welding rolls are on a straight line parallel to the track. The track, however, is not straight but curved, and the roof also has a varying curvature.

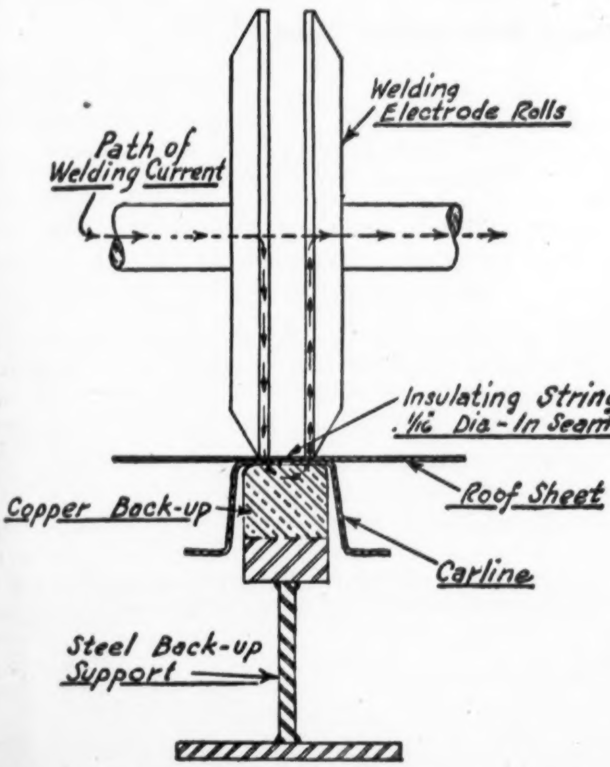

Fig. 2—Path of welding current through the electrode rolls, roof sheet, carline and copper back-up bar

In order to have constant welding speed at the electrode rolls it is necessary to vary the speed of the driving motor. This is accomplished by obtaining power for the driving motor from a motor-generator set. The voltage supplied to the driving motor is varied by means of a rheostat in series with the shunt field of the d.c. generator of the set. The rheostat is mounted on the welding unit and is operated by a cam track placed along the supporting track of the welding unit. By proper location of the cam track, it is possible to have constant speed at the welding rolls. It is necessary to speed up the welding roll on that portion of the roof with the smaller radius in order to avoid overheating of the spot welds due to the higher concentration of welding current.

The heat along the edge of the roof sheet tends to open up the joint due to the expansion of the edge. It is necessary to hold the sheets firmly and this is accomplished by four straps on each sheet.

Stiffeners to Side Sheets

Flat sides on railroad passenger cars are obtained by the use of internal stiffeners spot welded to the side sheets. The entire area of the side with the exception of clearances for the attachment of framing members is covered with corrugated stiffeners. These stiffeners prevent any distortion or buckling of the side sheets. There is a considerable amount of spot welding involved in the fastening of these stiffeners to the side sheets. A large multiple electrode machine with an indexing table has recently been installed to weld these subassemblies in large quantities. This machine, illustrated in Fig. 3, also utilizes the series welding principle. Two electrodes are in series with the copper plate on the table top serving as a back-up to conduct the welding current. Each pair of electrodes has a separate welding transformer. Spacing between the electrodes is adjustable and each electrode has individual pressure adjustment by means of springs.

All the electrodes are mounted on a ram, the vertical movement of which is toggle operated by means of hydraulic cylinders. Provision is made for a normal operating stroke and an additional retraction stroke to clear higher objects.

The main feature of this machine is its automatic operation in indexing and movement on the table. The table is made twice the length required for the work so that one end can be unloaded and loaded while welding is taking place on the other end. Indexing is accomplished by means of phototube relays. The light sources and phototubes are mounted near one side of the table so that an indexing pattern on the table will control them.

Fig. 3—Automatic multiple-electrode spotwelding machine for welding corrugated stiffeners to the side sheets

Fig. 4—The indexing pattern for the welding of side-sheet stiffeners is set up by removing loose rivets in the two rows of holes in the table, thus permitting light to pass through and operate phototube relays

Fig. 4 shows the indexing pattern being set up. Two rows of holes the full length of the table are placed in such a position as to pass between the phototube and light source. All holes are filled with loose rivets so that light cannot pass through. When a rivet is pulled out of a hole, it permits light to pass through, operating the phototube relay and welding in the position selected. Any pattern of welding desired can very easily be set up. The second row of holes controls retraction of the electrodes. By selecting the proper rivet to pull out of the hole, the electrodes can be made to retract in any desired position. The table is automatically controlled so that, if desired, it will upon finishing the work on one end of the table, automatically move to the center and start welding on the work that has been loaded on the other end of the table.

Side Machine

The sides of the railroad passenger car are spot welded with an automatic machine of the type shown in Fig. 5. The work is capable of resisting pressure of the electrodes anywhere over its surface. The full side of a car is fitted up at one time and four such fixtures are provided. Welding is performed on two of the fixtures, while the other two are being unloaded and loaded. Three machines and a suitable number of controls are installed so that two machines can weld simultaneously on any one of the fixtures desired.

The spot-welding machine has a welding unit that consists of transformer, electrodes and air cylinders. This unit runs up and down vertical guides and is indexed automatically by means of an electronic sequence panel. The welding unit is rotated 90 deg. for welding horizontal members of the framing to the side sheets. When welding horizontal rows the entire machine indexes along the track on which the machine is mounted. Indexing of the machine is accomplished by means of a motor which is started and stopped for each index. The length of time that the motor runs is governed by a sequence panel. The spacing of the spots is controlled by turning a dial on the sequence panel. A plugging relay gives quick braking for the motor and accurate spacing. The motor is especially designed for frequent starting.

Two electrodes which are connected in series with the welding transformer pass current through the work and the copper back-up plate, thereby making two welds at every operation. Movement of the electrodes in and out and starting of the welding current are controlled by an electronic sequence panel.

Power, Water and Air Supply

The roof and side machine move along tracks that are over twice the length of a railroad car. Welding power, control, air and water lines must connect to the machine at all positions. This becomes quite complicated when about 40 control wires, in addition to power cables, and water and air hoses are involved. All of the leads are brought up in the center of the jig and pass around sheave wheels on a movable carriage and then to the welding machine. A counter weight is attached by means of a cable to the sheave carriage. This serves to hold the carriage as far from the welding machine as the length of the leads will permit, thereby keeping slack out of these cables and hoses at all times.

Controls

The three machines described all have electronic controls that perform the following functions: (1) Sequencing of operations; (2) indexing of welds; (3) timing of welding current; (4) interruption of welding current, and (5) maintaining welding current constant.

Fig. 5—An automatic machine spot welds the car sides

The sequence panels and synchronous control panels have been described in various papers. Phototube control for indexing of welds is novel in the resistance welding industry, especially in the indexing of a table having such a large mass. The electronic current compensator has been found to be a very useful instrument. Remarkable consistency in welds is produced by the use of this control that compensates for line voltage variations and impedance variations in the welding current.

Standard single spot type machines are used in miscellaneous subassemblies such as stiffeners to roof sheets, battery boxes, partitions, cabinets, lockers, etc.

EDITORIALS

Inspection Methods Extend the Life of Parts

It isn't so many years ago that the process of making inspection of locomotive and car parts in the process of manufacture and while in service was, of necessity, a rather crude affair that was limited to visual inspection and the good old standby of coating the parts with whiting. Not a small part of the success of this method depended upon the skill and experience of the mechanic that was doing the job. It is unnecessary to emphasize the fact that these early inspection methods left a lot to be desired in the matter of detecting flaws and service defects for many of them were never detected at all with the result that service failures of locomotives and car parts not only added substantially to the cost of maintenance but, in many instances, wrecks added their toll of loss of life, injuries and property damage.

One of the first major steps in the improvement of testing methods was the introduction of the magnetic flux method which has by now become so widely used and so thoroughly developed that it is adaptable to practically all of the major parts of the running gear of either locomotive or car. Of all of the parts the inspection of which by this method has proved most valuable to the railroads locomotive rods, piston rods, motion work parts and axles, and tender and car axles stand out in the forefront. Never until this method of testing was adopted did the average mechanical officer and supervisor realize the extent to which defects existed in service and, particularly in the matter of car and tender axles, it is now almost universal practice to inspect axles as they go through the shop and eliminate those about which there is any question of their ability to perform a term of service without danger of failure. The fact that the total number of axles that have now been inspected is running into the hundreds of thousands and that, on many roads, it has been found that defects existed in as many as ten per cent of them has not only made it possible to eliminate much of the guesswork but it has given us valuable information by which we may be guided in future design and maintenance.

More recent inspection methods are the X-ray and the super-sonic. The X-ray has found definite application in the manufacture of many parts and particularly in the field of welding. The super-sonic inspection method has added to inspection practices that most desirable feature in maintenance work—the ability to inspect many locomotive and car parts without removal from the assembly and, in most cases, without disturbing adjacent parts. These features, today, when every hour of labor of any kind is a matter of increasing expense, are of extreme importance to the railroads.

Probably the most valuable feature of these improved inspection methods, from an economic standpoint, is the elimination of guesswork in the matter of miles, or months, of service of the parts in question. Even on those roads where an accurate and complete record of defects and failures has been kept the service life of parts had to be established somewhat short of the known record of ultimate life as established by the failures. Needless to say, mechanical people rarely ever erred on the side of being too liberal in the matter of service life, as measured by mileage, if they could help it, with the result that, to be on the safe side, many important locomotive parts were taken out of service on the basis of an established mileage, "for safety's sake." How much further these parts might have continued to run was an unknown quantity.

The super-sonic method of inspection has removed the mystery from parts in service. It is now not only possible to determine, as frequently as may be desired, the actual condition of many parts and be relieved of concern as to their condition but, in case defects are located, it is possible accurately to determine the location and extent of the defect. No longer is it necessary arbitrarily to remove parts from service because of doubt and this fact alone may extend the service life of many parts far beyond the previously established limits—in fact, in many cases the ultimate limit of wear may well prove to be the ultimate service life.

Production Welding

The adaptation of welding to the construction of both freight and passenger cars in the shops of the railroads and car builders has resulted in the development of welding equipment and accessories and of welding methods that place the production of the cars on an assembly line basis. Mass-production methods are particularly characteristic of freight-car shops where cars are turned out by the hundreds and the repetitive type of work makes the use of specialized welding machines, jigs and positioning devices not only economical but a necessity for quantity and quality output. The same situation exists in some of the builders' plants, however, with respect to passenger-car construction where the large orders for new cars have required the use of ingenious welding equipment in order to control the

quality of the product and increase the speed of production.

An idea of the advances made in the welding equipment and methods used in the fabrication of railway cars may be obtained by a review of the articles dealing with welded freight-car construction that have appeared in the two preceding issues of the *Railway Mechanical Engineer* and in the one on passenger-car construction that appears alsewhere in this issue. These articles describe welding set-ups in the shops of one railroad and one builder; a more complete picture of what is being done in the way of welded car construction and how it is being done will be presented as descriptive material on other facilities can be included in subsequent issues.

In the article in the March issue describing the building of welded freight cars at the shops of the Chicago, Milwaukee, St. Paul & Pacific a feature of the job is the use of jigs, fixtures and jig-positioners that hold the parts in accurate alignment and also position them for down-hand welding. Another feature is the breakdown of the operations into subassemblies that can be easily handled and adapted to production work. In this shop most of the welding is done manually, the welding method generally used where the volume of work is not sufficient to justify the installation of automatic equipment. It is in the builders' shops, as shown elsewhere in this issue, that automatic features have been perfected and applied to welding equipment. They reduce the labor costs, which are inherently greater when manual operation is employed, and improve the quality of the results, which are consistently better when the vagaries of welding operators can be eliminated.

Along with the introduction of automatic welding machines and the development of better accessory equipment another contributing factor to the success of welded fabrication is the adaptation of the spot system to both manual and automatic welding procedures. This system gives the assembly line the flexibility to handle more than one particular type and design of car and at the same time affords the shop an opportunity to tool up for each assembly operation.

These advances in welding tools and accessories are easy to spot when one walks into the shop. Less evident, but fully as important, are the improvements made in welding technique and in designing parts for welding. Distortion, particularly in the welding of relatively thin sections, is one of the problems that requires considerable skill to hold it within reasonable limits. The selection of the right filler metal for a particular job is important and can only be made by competent welding engineers. Some of the other factors that are not immediately obvious but which may affect the serviceability, strength and appearance of the final product include prestressing by the introduction of reverse camber, joint design, the method of positioning and clamping the parts to be welded, and the type and control of the welding process. All of these factors are being considered in welding and they are mentioned here to show that production welding is not just a matter of installing automatic machines, jigs, fixtures and positioners, important as they are, but that a lot of know-how and "tricks of the trade" also enter into the building of welded railroad cars if good results are to be obtained in the final results.

Some of the welding installations now in use are amazing to those who have not followed closely the development of welding as a fabricating tool in recent years. It is well known that the railroads were pioneers in the application of welding to equipment repairs and later used it for the building of a limited number of cars and locomotive tenders of welded construction. But the extensive use of welding as a major fabricating method for the mass production of cars is a relatively new development that appears to have been accelerated by wartime requirements. It is a development that shows welding to be an adaptable and flexible process that is only starting to enjoy the popularity warranted by its advantages.

Improvements Long Overdue

Beginning in the early thirties the railroads of this country began improving most of their freight and passenger services to an extent that amounted to a virtual revolution. During this era of improvement, which is still progressing, unfortunately one group of services has escaped the benefits of progressive thinking. Local and commuter service and equipment, particularly the latter, remain about as they were several decades ago. The time might now be appropriate to devote some attention to methods for bettering this service, with particular regard to improving the equipment. While any decision as to whether new equipment should be built or present equipment renovated will depend upon the individual case; the important thing is the attractiveness of the finished product. This should eliminate as many of the present disadvantages of local railroad service as possible and at the same time provide additional comforts and conveniences.

Probably the most important single point to be kept in mind in any new design, particularly for summer-time travel, is the combination of cleanliness and temperature. This problem, unfortunately, is also the hardest to solve. Diesel-electric or electric power, although cleaner than steam, is not the complete solution as any dirt-laden summer-time rider on an electrified line can testify. Air conditioning or air cooling is expensive to install and the economic problem is severe where the equipment is idle a large part of the time. For a means of cooling to be very helpful it must have the cars cool when the passengers board them and not an hour or so later as is often the gripe of passengers on even the finest long-distance trains. Indeed, the interior temperature of coaches which have been soaked in the sun's rays

for eight or nine hours, with doors and windows closed, constitutes a major part of the problem, particularly in commuter service.

Despite the expense involved a few coaches in commuter service were air-conditioned some years before the war, with much satisfaction to the patrons of the railroad who rode them. The possibilities of materially lowering the temperature of hot cars before they are placed at the station platform for loading, while not too hopeful, should be thoroughly studied.

From the standpoint of the railroad, any outlay for the benefit of commuters is considered an unprofitable investment for two reasons; first, because the passenger-mile revenue is low and, second, because of the low daily mileage averaged by the rolling stock involved in rendering the service. But the neglect which has been the lot of this service is one of the greatest sources of dissatisfaction with the railroads which they receive from any of their patrons. It is exceedingly unhealthy to allow such a situation to continue. It is a source of infection detrimental to the health of all the public relations of the roads rendering this kind of service.

Postwar Emergencies

Many emergency measures were necessary to keep work going through railroad shops during the war. With the cessation of hostilities, it was felt that things would get better. Actually, in many instances, they have become worse. Priorities helped the railroads during the war, but now there are no such means for taking care of material shortages.

Electric motors constitute an important example of the hazards involved. This applies to nearly all motors and specifically those which must be produced by the builder after an order is received. The best the manufacturer can offer is probably a delivery in 40 weeks. It may be possible to have a failed motor rewound in 12 weeks at a cost 50 per cent greater than that of a new motor, but this is not a satisfactory "out" for an emergency.

It is, therefore, particularly important to check motors on vital equipment such as cranes, turntables, etc. Such motors run day in and day out without complaint and it is quite natural that attention is given to other work. The cranes and the tables, too, have been running for years without adequate maintenance, and it is quite possible that bearing wear and misalignment has increased the motor load as much as 50 per cent.

There may be spare motors, or spare armatures available, but it is quite likely these have gone into service at some time during the past five years.

Checking motor loads, motor and bearing temperatures, commutator and brush wear and machine conditions, at this time when deliveries are so slow, may easily mean the difference between satisfactory operation and a costly shut down.

NEW BOOKS

SPECIFICATIONS FOR STAINLESS STEEL WELDING ELECTRODES.—*Published by the American Welding Society, 33 West Thirtyninth street, New York 18, and the American Society for Testing Materials, 1916 Race street, Philadelphia 13, Pa. 13 pages, 6 in. by 9 in. Price, 25 cents.*

With issuance of the *Tentative Specifications for Corrosion-Resisting Chromium and Chromium-Nickel Steel Welding Electrodes* (AWS Designation A5.4—46T; ASTM Designation A298—46T) the AWS-ASTM Committee on Filler Metal has completed one more step in a program which is intended ultimately to provide a complete set of specifications for all types of filler metal used in welding ferrous and non-ferrous metals by the various welding processes. The new specifications, patterned after the Tentative Specifications for Iron and Steel Arc-Welding Electrodes for mild and low-alloy steel electrodes, provide classification and test requirements for twenty-four classifications of electrodes. The classifications are grouped in six series covering the stainless steel types commonly identified as 19-9 (or 18-8), 25-20, 18-12 Mo (or 18-8 Mo), 19-9 Cb (or 18-8 Cb), 16 Cr, and 4 to 6 Cr-Mo. Each of these series includes classifications for an all-position d.c. electrode, an all-position a.c.-d.c. electrode, a d.c. downhand electrode, as well as an a.c.-d.c. downhand electrode.

To provide users of the Specifications with assistance in the selection of the proper electrode for a given application, there is included as an appendix the Guide to the AWS-ASTM Classification of Corrosion-Resisting Chromium and Chromium-Nickel Steel Welding Electrodes in which the particular properties and uses of each classification are discussed.

ELEMENTS OF MECHANISM.—*By Peter Schwamb, Allyne L. Merril and Walter H. James. Sixth edition, revised and rewritten by Venton L. Doughtie. Published by John Wiley & Sons, Inc., New York. 428 pages, 6 in. by 9¼ in. Price, $4.00.*

The first edition of this book was written during 1885 by Professor Peter Schwamb and for many years it was used at the Massachusetts Institute of Technology in the form of written notes. Dealing with the application of the fundamental principles of kinematics in the field of mechanical movements the book covers the more common and fundamental machine elements and presents a study of their motions when combined in certain definite ways. The sixth edition retains the presentation of the fundamentals of the motion and the forces transmitted by parts of a machine and introduces new illustrative examples and new problems throughout the text. All chapters have been completely revised. Machine parts studied include linkages, cams, gears, belts and ropes, and bodies in rolling contact. Analyses of motion, vectors and acceleration are also made.

Carbides on Railroad Jobs

Part II*

By Carroll Edgar†

For rough turning steel forgings, a carbide tool having a negative back rake of 5 deg. with a negative side rake of 5 deg. has been found to be satisfactory. In most instances, these angles are confined to the chip breakers rather than to the entire blank.

On turning, negative rake carbide tools will give even longer operation between grinds if the cutting edge and nose radius are honed at a 45 deg. angle. The width of the chamfer thus formed should not be more than .005 in. or .010 in. at the most for optimum results. Honing removes any ragged edges the cutting edge may retain from sharpening and also tends to prolong life between sharpenings by protecting the cutting edge against the "sawing" action of scale, if it is present on the work piece.

The nose radius on a negative rake carbide turning tool should be of the same proportions as on the conventional positive rake turning tool. If the nose radius is too large, the tool will develop a tendency to chatter; if too small, then the tool will break down. Relief on negative turning tools are also the same as on conventional tools—i.e., from 5 deg. to 7 deg. side and front relief angles.

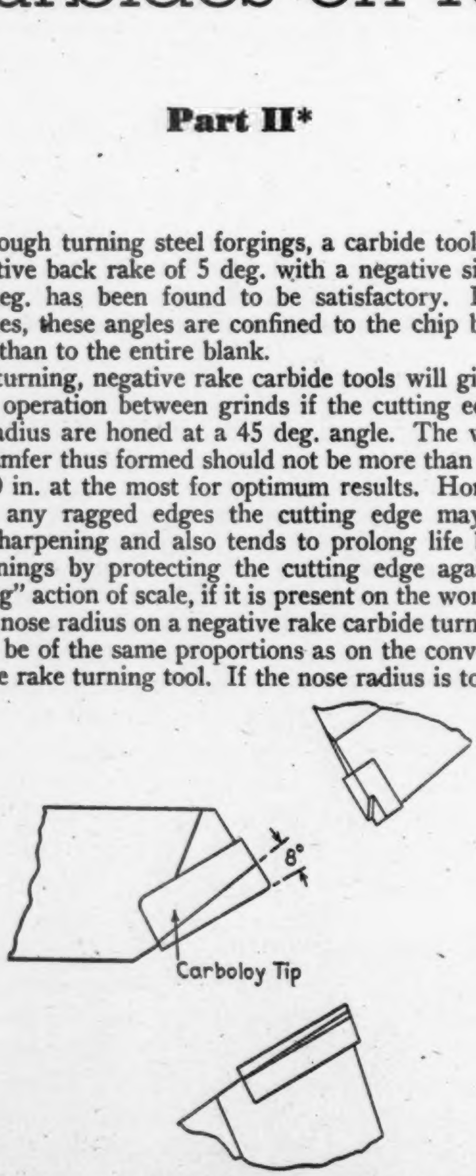

Fig. 1—Sketch of a typical carbide turning tool showing the double negative rakes—5 deg. negative back rake and 5 deg. negative side rake

It has been found preferable, wherever possible, to use a side cutting edge angle of between 10 deg. and 30 deg. on the turning tool. Such a side cutting edge angle cases the tool *into* the cut and *out of the work* at the end of the cut; whereas a tool with a zero side cutting edge angle *jumps* out of the cut, a condition which can easily lead to tool breakage.

In some instances, these negative back rakes have been carried to such an extreme degree as to obtain what is commonly called a "shear" type tool. It is intended only for taking interrupted roughing cuts on large diameter work. The shear type tool is so designed that impact following an interruption in cutting is minimized by the gradual entry of the tool into the cut. With a negative back rake the initial load is taken back away from the nose of the tool. Experience has proved that the shear type tool can take the entire gamut of interrupted cuts, even on the hardest, toughest steels. It is not a cure-all however and should not be used as such.

Set-up for Negative Rake Tools

In general, the nose of a negative rake tool should be set centerline of the work piece or slightly above it, just as for other carbide tools. Speeds and feeds are also usually the same.

If coolant is used a copious flow should be directed either from the bottom or from one side of the tool in such manner that the chip will not act as an umbrella to keep the coolant away from the nose of the tool. It is well to remember that negative rake turning of steel generates considerably more heat in the chip that does conventional turning. Some of this heat flows into the tool, as a result of which a coolant is needed more often than when machining with positive rake tools.

Negative rake turning of steel—no matter what the size of the work piece—may require slightly more power than does conventional turning. Usually, however, this imposes no further requirements on the machine than those called for by carbide tools in general.

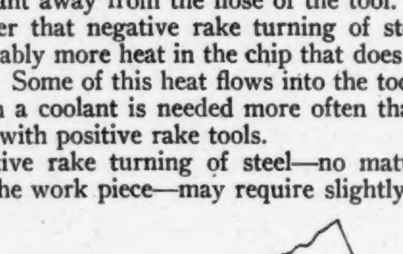

Fig. 2—Enlarged view of the chip breaker section of the tool shown in Fig. 1 to show the negative rakes

* This is the conclusion of an article, Part I of which appeared in the April, 1947 issue, page 189.
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Milling With Carbides

The application of carbides to milling cutters involves the same basic principles that apply to taking interrupted cuts with single point tools.

Axial rake angles in current use vary between negative 3 deg. and negative 15 deg. For general purpose facing and straddle milling jobs, an 8 deg. to 10 deg. negative axial rake angle is satisfactory. The negative axial rake angle should always be large enough to protect the radius or chamfer on the corner of the tooth. In this way, the impact load is taken at a distance from the corner when the tooth contacts the entering side of the work.

The radial rake angle (which corresponds to the top side rake on single point tools) determines the free cutting action of a milling cutter. Generally, radial rake angles for milling steel range between 8 deg. positive and

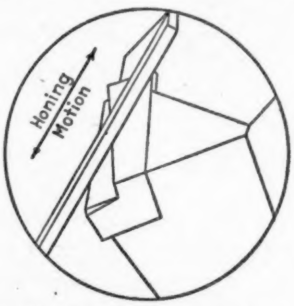


Fig. 3—Method of honing the cutting edge of a negative rake turning tool at a 45-deg. angle

10 deg. negative. Negative radial rakes as great as 10 deg., however, may be considered extreme. On milling applications which permit the use of a bevel angle on the cutter, a positive radial rake is advantageous for soft steels, and a negative angle for hard steels. A practical rule for cutters of this type is to use about 8 deg. positive radial rake for steels below 200 Brinell and gradually reduce the radial rake to 5 deg. negative for steels in the Brinell range of 325 to 500. For operations involving milling to a square or almost a square shoulder, a negative radial rake of 3 deg. to 7 deg. should be used to assure maximum strength at the cutting edge even when it means loss of cutter efficiency.

The bevel angle on a face or straddle milling cutter serves the same purpose as the side cutting edge angle (lead angle) on a single point tool. It protects the chamfer or radius when the cutter first touches the work and tends to increase cutter life. For most face or straddle milling operations the cutter mills *past* the work. In such a case, a bevel of 15 deg. is usually satisfactory. However, where a 15 deg. bevel is not enough to allow the chamfer or radius to enter the cut *last,* the bevel should be increased and may be as large as 35 deg. if necessary. When a 0-deg. bevel angle must be used, the radial angle should be 3 deg. to 7 deg. negative. The width of the bevel angle should be enough to cover the full depth of cut. The relief angle along the bevel angle or along the outside diameter of the cutter should be ground between 4 deg. and 7 deg. up to the edge. Use 4 deg. for harder steels and 7 deg. for softer steels. The clearance angle should be ground up to a land $\frac{1}{32}$ in. to $\frac{3}{64}$ in. wide.

Always grind a chamfer or radius on milling cutters. This removes the extremely frail, sharp corner which tends to flake off when the cutter is in use. A radius gives the greatest strength and should be used if suitable grinding equipment is available and the finished work specifications permit.

The face of the cutter should be ground at 2 deg. to 4 deg. concave from the toe towards the heel. Clearance below the heel should be ground at 5 deg. to 7 deg. making the face $\frac{1}{8}$ in. to $\frac{3}{16}$ in. long. This increases the distance between the braze line and the cut and eliminates pickup of work material when the cutter is operating.

Milling Speeds and Feeds

Higher speeds in feet per minute should be used in general when milling steel than are used with single point tools. The best speed for a milling operation is dependent upon the hardness of the workpiece. The following table shows the recommended speeds for a wide range of work hardnesses:

Brinell hardness	Speeds in sq. ft. per min.
150	530 — 660
200	450 — 570
250	400 — 500
300	350 — 450
350	320 — 400
400	290 — 360

Optimum feed (table travel) in inches per minute should always be determined from the feed per tooth basis instead of from the too-often used "cut and try" method. A .005-in. to .008-in. feed per tooth will produce about the maximum number of accurately finished pieces per grind when using face mills or straddle mills that cut past the work. Lighter feeds per tooth can be used but indications are that the number of finished parts per grind will decrease. However, if the milling machine is in good condition and has ample power available; if the fixture is rigid and is designed to bring the cut close to the milling machine table; and if the cutter itself is properly designed, the feed per tooth can be increased to .015 in. without any harmful effect on cutter life.

Flywheel Effect

When milling steel with carbides, it is highly desirable to use a massive milling cutter body in order to produce the "flywheel" effect. This reduces the shock or rebound from the impact of the cutting edge against the work; provides a smooth cutting action; results in an increased number of piece per grind; and is less detrimental to the machine. The flywheel effect enables the machine to take momentary peak loads considerably greater than that of the rated motor capacity. When it is not possible to incorporate a sufficient amount of mass in the cutter body proper, it is recommended that auxiliary flywheels be added to the spindles or to the arbors in order to smooth out the operation.

Above all other things to remember when milling steel with carbides is this: RIGIDITY IS ESSENTIAL. This applies to both the machine and to the method of clamping the work. It is obvious that the machine should also be rugged enough to withstand all forces and shocks incidental to the operation.

Milling Cast Irons With Carbides

Cast irons have been milled with carbide tipped cutters in commercial practice for more than ten years. Steel types of cast irons; malleable irons; and irons with hard

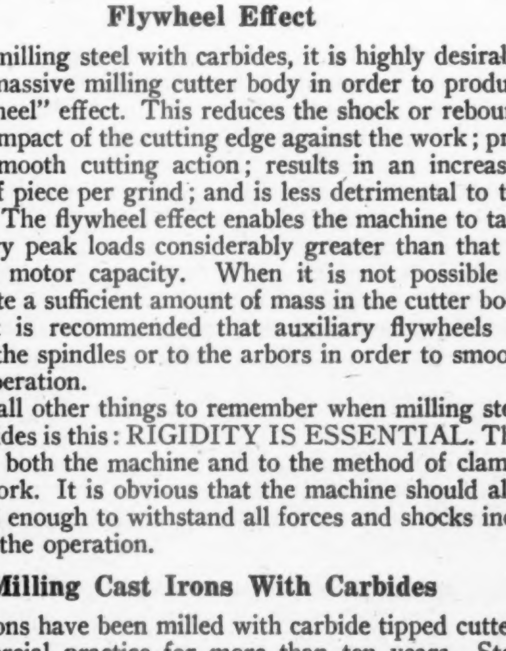
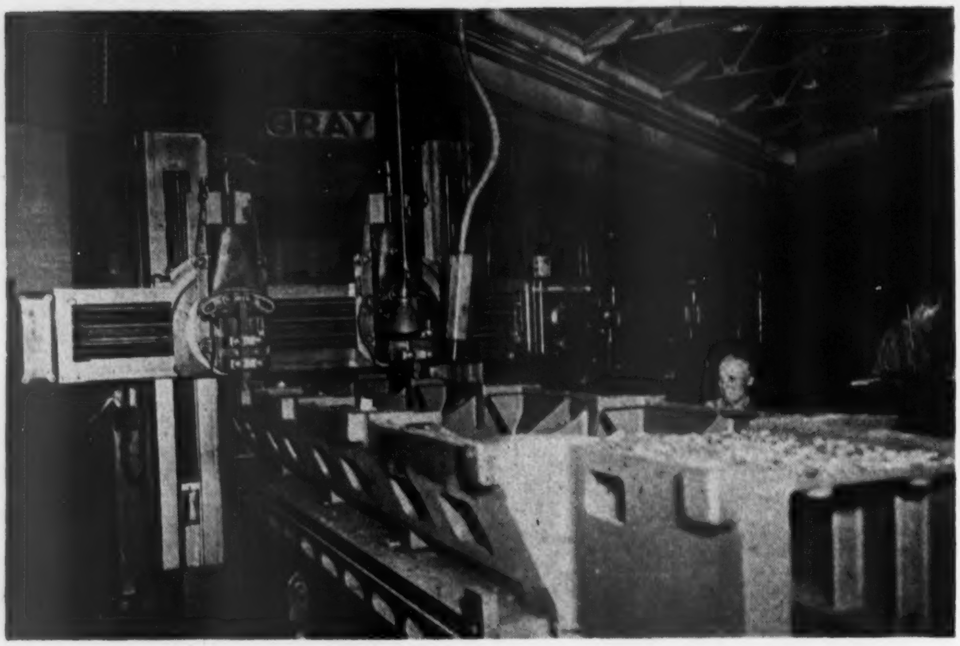


Fig. 4—Closeup of the honed edge of the tool shown in Fig. 3 illustrating the proper width of the chamfer



The rough machining of this bed casting at a surface cutting speed of 200 ft. per min. with a ⅜-in. depth of cut and .030-in. feed is made possible by the use of cemented carbide planing tools which can take such impact loads as this job imposes successfully

sections are also being carbide milled. Most of the cutters are tipped with straight tungsten grades of carbide and are made with a 3 deg. to 7 deg. positive axial rake and a 3 deg. to 7 deg. positive radial rake angles. The face milling cutters are so ground that all of the cutting is done on 30 deg. to 40 deg. corner angle.

Cutting speeds range between 175 and 375 surface f.p.m. The lower end of the range is best for finishing cuts (when positive cutting angles are used). When the cast iron section shows hard spots, or when the material approaches steel in its characteristics, speeds as high as 375 f.p.m. have been found to be satisfactory. In this case milling cutters should be of steel-cutting carbide grade and have a negative 10 deg. axial and a negative 10 deg. radial rake. Feed per tooth can range between .008 in. and .020 in., although it is suggested that as heavy feed as possible be used in this instance.

Steel Milling

Steel milling is divided into three classes based on qualities required in the carbide. All qualities are relative, of course since *all* grades of carbide for instance are more *wear* and *abrasion* resistant than other tool materials. However, simple tungsten carbides are more wear resistant than are the tungsten-titanium-tantalum carbides.

For rough milling of steel—where the chip load is heavy—maximum cratering resistance is usually of primary importance. Toughness, wear resistance, and edge strength under impact loading—in order of their relative importance—are also required characteristics of the carbide suitable for such work.

A straight tungsten carbide is suggested for finish milling of cuts and feeds have to be light. Under such conditions the cutting edge has to resist more abrasion than where heavier cuts or feeds are possible.

Milling Cast and Malleable Irons

Cast and malleable irons are here divided into two groups since many present day irons approach steel in their machining characteristics. "Steel cutting" grades of carbides frequently give better results on malleables than do the straight "iron cutting" grades.

This group includes those irons with hard spots or hard sections, inasmuch as such sections frequently control the selection of the carbide by making *toughness*—rather than *abrasion resistance*—the limiting factor as regads tool life.

For milling the simple cast and malleable irons, *abrasion resistance* is usually the important factor in tool life. Straight tungsten carbides are usually best for this work. Where work sections are particularly rough, the tougher grades of straight tungsten carbides provide somewhat greater life. On smoother castings and for making finishing cuts, the more abrasion resistant grades of the straight tungsten carbides will usually give longer life and a flatter finish.

Use of Coolants

Carbide tools generally function best when no coolant at all is used. However, on certain jobs—where it is necessary to maintain a high degree of dimensional accuracy, for instance—a coolant may be needed to prevent distortion of the workpiece. In such cases, a solution of one part soluble oil and from thirty to forty parts of water will give excellent results. This variation in the proportion of water to oil is made necessary by the variations in the hardness of water in various parts of the country. The 30 or 40 to 1 mixture is not only an excellent coolant but also keeps the ways of machines free from rust.

The fundamental principle in applying a coolant to carbide jobs is that the liquid be supplied copiously and at a high velocity. Carbide tools, by virtue of their ability to remove more stock per minute necessarily cause a greater temperature rise which requires more coolant to keep the temperature of chips to a minimum. The heavy flow of liquid should be directed at the cut from underneath the tool; or at the cut from the side of the tool where the chip flow has the least tendency to interrupt the flow of cutting fluid. An intermittent flow of coolant—whether caused by an inadequate flow, an "umbrella" action of the chip, or any other reason—always tends to reduce tool life.

Care of Tools

Proper care of carbide tools is necessary for optimum results. Carbide tools should never be run until they will no longer cut or the machine stalls or slows down. If the cutting edge is restored as soon as it starts to dull slightly, overall tool life will be greater, cutting efficiency will be increased, spoilage decreased, etc. Tools should be periodically inspected for cutting condition, or removed for

grinding at specified intervals. If dull, they should be replaced and reground.

Carbide tools can be re-ground at high rates of speed when correct grinding technique is employed. While grinding, the tools should be kept moving continually over the surface of the grinding wheel. Tools should never be dipped in water or other coolants while being ground, or even shortly after the grinding has been completed. If a coolant is used during tde grinding process, it should never be administered in "dribbles." The work should be "drowned" by a large, continuous flow of the fluid, or else the grinding should be done dry. Silicon carbide or diamond wheels are required to sharpen the carbide portion of the tool.

Questions and Answers On Locomotive Practice

By George M. Davies

(This column will answer the questions of our readers on any phase of locomotive construction, shop repairs, or terminal handling, except those pertaining to the boiler. Questions should bear the name and address of the writer, whose identity will not be disclosed without permission to do so.)

Drawbar Pull

Q.—What is the relation between the tractive force and the drawbar pull of the same locomotive?—F. E. B.

A.—Drawbar pull at the back of the tender is equal to the maximum tractive force of the locomotive minus the engine and tender resistance, which is made up of the following components:

1—The engine or machine friction, which is the energy required to overcome the internal machine friction of such parts as the driving wheels, pistons, valves, crossheads, etc. This may be taken at 25 lb. per ton of weight on driving wheels for all speeds, track resistance included, on non-roller-bearing engines.

2—The grade resistance based on the weight on the drivers in tons.

3—The resistance of the engine truck, trailing truck and tender truck based on the weight in tons on these trucks.

4—The head-end air resistance of the engine.

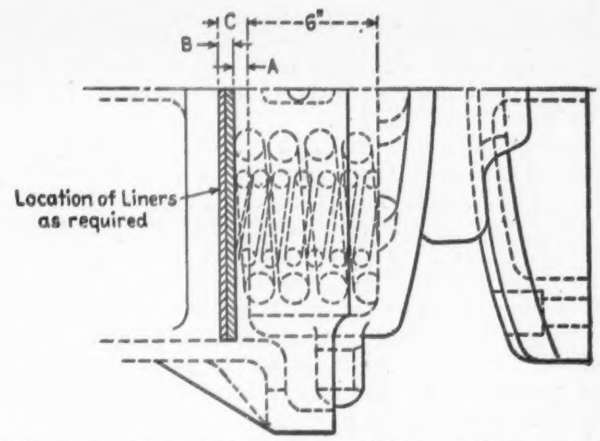
5—The uncompensated curve resistance per ton of locomotive weight.

The sum of the above makes up the total locomotive and tender resistance for a given set of conditions and must be deducted from the available tractive force to obtain the drawbar pull at the back of the tender under those conditions.

Adjustment of Radial Buffers

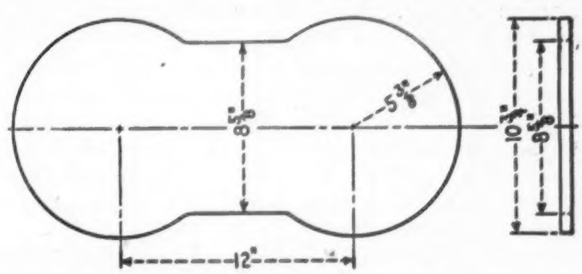
Q.—On locomotives equipped with Type D radial buffers, what adjustment should be made to keep compression on the springs in the tender casting?—F. J. R.

A.—As an example, the method of making adjustment to provide the required initial compression of the springs in a Franklin Type D radial buffer having A. A. R. Type G springs will be discussed. With a new drawbar and pins dimension *A*, the distance between the back edge of the adjustable chafing casting and the spring pocket seat, should be 5⁄8 in. for A. A. R. Type G springs, with no liners used. To restore springs to the required initial



Subtracting *A* from *C* gives the total thickness of liners required

compression, check dimension *C* through the open space on either side of the buffer casting. Apply liners as required, the thickness of liners *B* to equal the difference



The liners to be of steel plate of the shape shown, and made in thicknesses of 1⁄4 in. and 1⁄2 in.

between dimensions *C* and *A*, the reference dimension *A* depending on the type of springs used. The maximum thickness of the liners should not exceed 1 in.

Air Brake Questions and Answers

The 24 RL Brake Equipment for Diesel-Electric Locomotives—Parts of the Equipment—Locomotive A Unit

517—*Q.—What limits the reduction in pressure at a rate to produce a service application?* A.—A choke in the slide valve passage limits the reduction in pressure at a rate to produce a service application.

518—*Q.—How is the passage from the equalizing discharge valve connected to the exhaust?* A.—(c) The passage from the equalizing discharge valve *82* is connected to the exhaust by slide valve *114*. This permits the reduction of brake pipe air and the application of the brake.

519—*Q.—Is the locomotive power shut off when a safety control application is made?* A.—Yes.

520—*Q.—How is this accomplished?* A.—(c) Main reservoir air is connected through a port in the slide valve to the power control switch pipe passage which operates the power control switch to shut off the locomotive power when a safety control application is made.

521—*Q.—Can the safety control application be released in Release, Running or First Service positions?* A.—No.

522—*Q.—Explain why this release is not possible.* A.—(e) The passage from the top of piston *112* is connected to a passage leading to the rotary valve and which connects to the exhaust in Release, Running and First

Service positions of the brake valve handle. Thus, as long as the automatic brake valve handle remains in any of these positions the safety control application cannot be released.

523—Q.—What provides for a split reduction of brake pipe pressure during safety control or Train Control application? A.—(f) The passage from the first suppression reservoir is connected to the passage leading to the split reduction timing valve chock *143*, (Section *C-C*) and to the diaphragm chamber of the split reduction valve. The suppression reservoir air holds the split reduction valve diaphragm down separating the first and second reduction reservoirs to provide for a split reduction of brake pipe pressure during safety control application. (g) The reduction limiting reservoir exhaust passage to the brake valve rotary valve is disconnected, which prevents venting the first reduction reservoir at the rotary valve in the brake valve. The split reduction timing valve *121*, (Section *C-C*), provides a split service reduction of brake pipe pressure during safety control application.

524—Q.—Explain the operation when safety control application is made. A.—When a safety control application is made piston *112* is moved to application position. Air from the first suppression reservoir is connected to split reduction valve chamber around diaphragm nut *126* and timing choke *143*. This deflects the diaphragm *124* which seats reduction valve *121* and prevents the flow of equalizing reservoir air into the second reduction reservoir and exhaust, thus the equalizing reservoir air reduces into the reduction.

525—Q.—When is the split reduction valve opened? What then happens? A.—Timing valve *121* is opened when the air pressure in the first suppression reservoir and in the chamber around diaphragm nut *126* has reduced sufficiently through timing choke *143*. The combined volumes of the equalizing reservoir and the reduction reservoir then equalize past the split reduction valve *121* into the second reduction reservoir to provide a full service reduction.

526—Q.—Can the safety control feature be cut in or out without interfering with the normal operation and function of the brake valve? A.—Yes.

527—Q.—What is provided for this purpose? A.—The safety control and train control cut-out cock *134* section *B-B*.

528—Q.—How can it be determined as to what position the cut-out cock is in? A.—The In and Out positions are indicated on the body.

529—Q.—What steps are taken to prevent unauthorized manipulation of this cut-out cock? A.—The cock is sealed in the In position by a car seal through slots in the handle *138* and body cap to prevent unauthorized opening.

530—Q.—Mention a special feature in connection with the cut-out cock handle. A.—The handle is provided with a spring latch *139* which requires a pause in mid-position when moving the cock handle from one position to another.

531—Q.—Why is this pause necessary? A.—To avoid a quick reduction in pressure in the chamber on top of application piston *112*, which would permit the higher air pressure under the piston to move it and cause a brake application.

532—Q.—What is the cut-off valve used for? A.—The cut-off valve *151*, (Section *C-C*) is used to cut off the supply connection between the automatic brake valve and the brake pipe during a safety control brake application.

533—Q.—Explain the operation of the cut-off valve. A.—The piston spring *155* moves the piston cut-off valve to open position with the air pressures balanced on both sides of the piston. When the air pressure in the chamber around spring *155* is exhausted to the amosphere by the application piston slide valve *114*, the piston *146* moves to the closed position which seats cut off valve *151* and this cuts off the supply connection.

534—Q.—What does the filling piece portion contain? A.—The filling piece portion *25*, located between the application and pipe bracket portion, contains the double heading cock *29*.

Locomotive Boiler Questions and Answers

By George M. Davies

(This department is for the help of those who desire assistance on locomotive boiler problems. Inquiries should bear the name and address of the writer. Anonymous communications will not be considered. The identity of the writer, however, will not be disclosed unless special permission is given to do so. Our readers in the boiler shop are invited to submit their problems for solution.)

Cold Water Boiler Cooling

Q.—What are the advantages of cooling down a boiler with cold water at the time of wash out?—M. J. R.

A.—The 1943 Official Proceedings of the Master Boiler Maker's Association contains an interesting paper on "Blowing Down, Washing and Filling Boilers," which includes the methods used by the Canadian National in cooling down boilers with cold water. The advantages outlined are: a reduction in time that the engine is held out of service; the firebox work can be accomplished with a greater degree of comfort and speed when the boiler is cooled down to body temperature.

Scale and sludge do not bake on the tubes and firebox sheets. By keeping the water in the boiler until the boiler is cooled to a point where the back of the hand can be held on the firebox sheets, the remaining sludge and scale on the tubes and sheets will be kept in a moist state and can easily be washed off.

Regulations for Flue-Removals

Q.—It was necessary to remove a considerable number of flues when applying a patch to the shell of one of our Pacific-type locomotives. While these flues were out they were cleaned, inspected and safe ended. Will it be necessary to remove these flues at the next flue removal?—F. K. M.

A.—The I. C. C. Laws, Rules and Instructions for the Inspection and testing of Steam Locomotives and tenders and their appurtenances, Rule 10, provides as follows:

Flues to be removed.—All flues of locomotive boilers in service, except as otherwise provided, shall be removed at least once every four years for the purpose of making a thorough examination of the entire interior of the boiler and its bracing. After the flues are taken out the inside of the boiler must have the scale removed and be thoroughly cleaned and inspected. The removal of flues will be due after 48 calendar months' service, provided such service is performed within five consecutive years. Portions of calendar months out of service will not be counted. Time out of service must be properly accounted for by out-of-service reports and notations of months claimed out of service made on the back of each subsequent inspection report and cab card. The period for removal of flues, upon formal application to the director, may be extended, if investigation shows that conditions warrant it.

In order to comply with the above it would be necessary to remove all the flues even though some of them have been removed during the four-year interval.

Staggering Tube-Sheet Braces

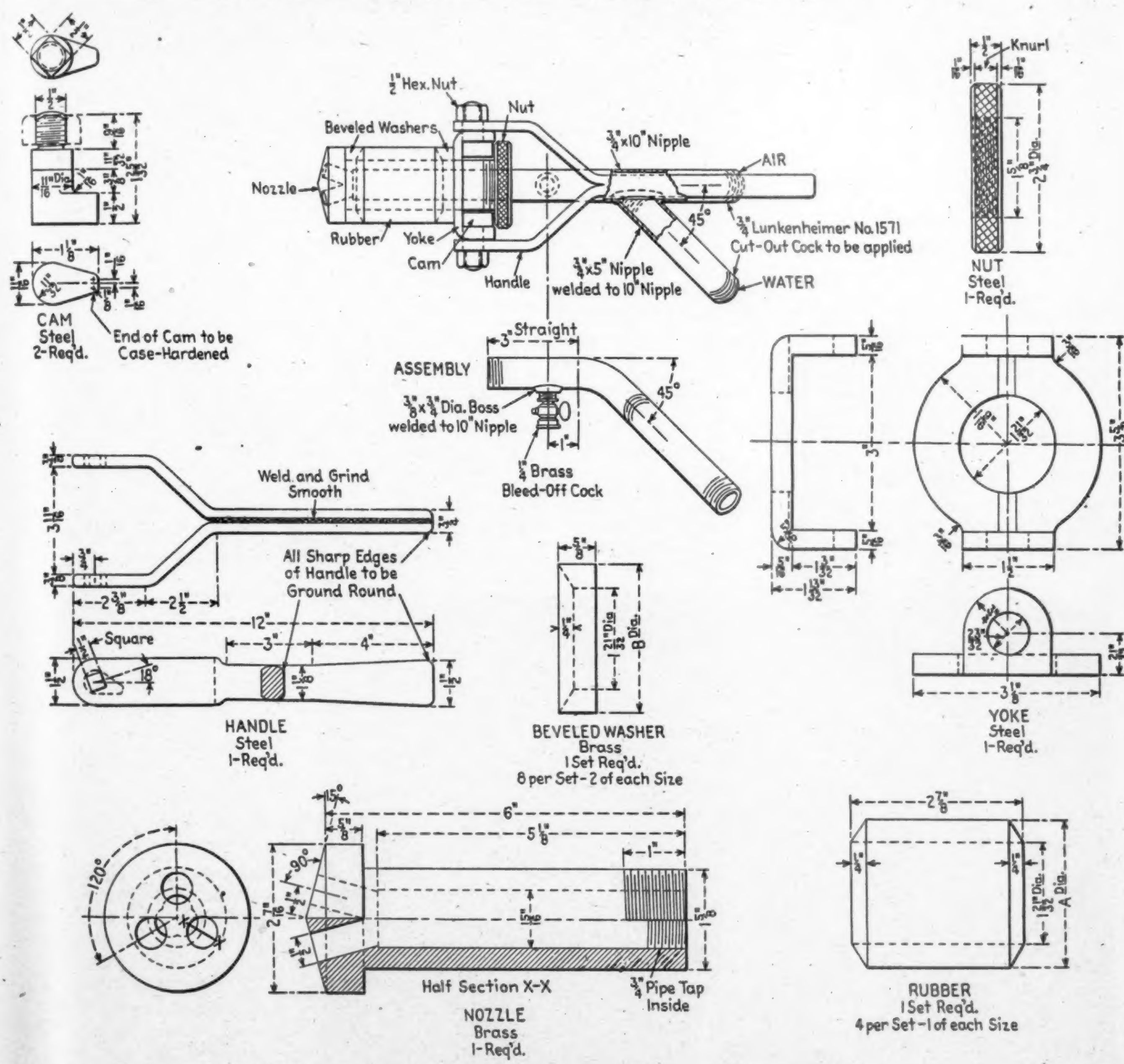
Q.—When applying rear tube-sheet braces, why is it necessary to stagger the brace feet on the shell course? If the brace feet were located the same distance ahead of the rear tube sheet a uniform length of stay could be used.—R. J. K.

A.—The reason for staggering the rear-tube-sheet brace feet where they are attached to the shell is to distribute the load on the stays over a greater area of the shell, thus keeping to a minimum the possibility of the shell cracking through the brace-feet rivet holes.

Washing Tubes and Flues

Considerable interest has been shown in the equipment developed by the New York Central for washing tubes and flues according to the method of cleaning these parts recommended by the Master Boiler Makers' Association. Both the equipment and the method were described in reports published in the 1945 and 1946 proceedings of the association and in an abstract of the 1945 report that appeared on page 594 of the December, 1945, issue of the *Railway Mechanical Engineer*, but construction details of the equipment were not included in the reports. These details are given in the accompanying drawings.

The equipment consists of mixing nozzle, in which air and water are combined. This is constructed with a rubber insert that can be expanded to lock the device in the flue or tube during the washing operation. For the different sizes of flues and tubes the diameter of the rubber insert used with the equipment is varied as shown in the table under the drawings. The association recommends that the nozzle be connected to a water supply (washout line) with a temperature not over 120 deg. F. and to an air supply having a pressure of at least 100 lb. per sq. in.



Flue Size, in.	A	B	Flue Size, in.	A	B
3¼	2-7/16	2-7/16	4	3-1/8	3-1/8
3½	2-5/8	2-5/8	5⅜—5½	4-1/16	4-1/16

Details of the New York Central's flue washing equipment

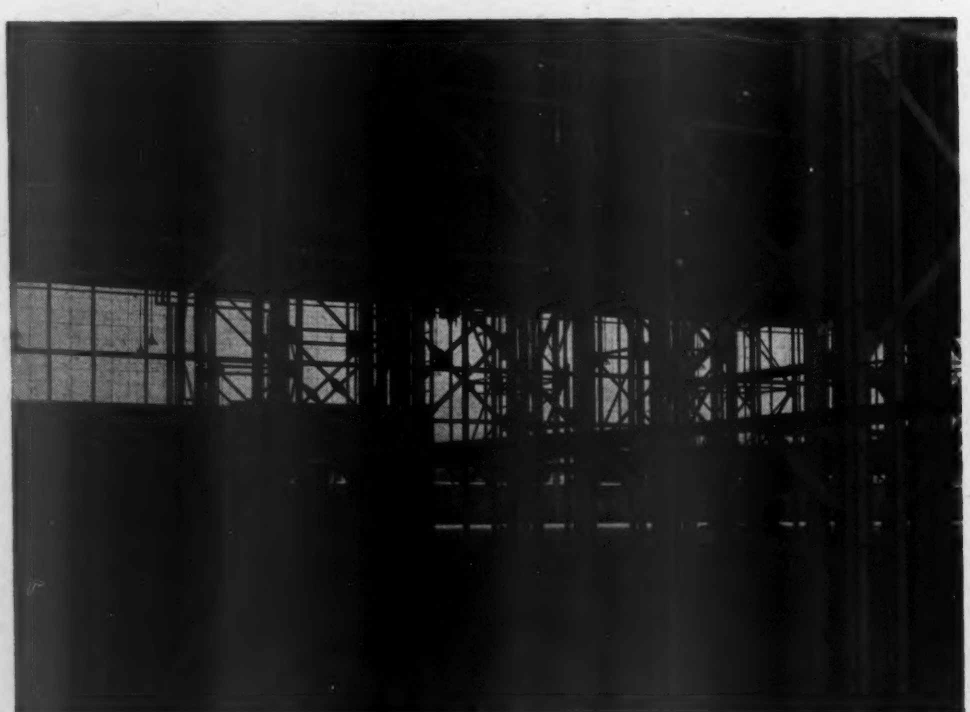
With the Car Foremen and Inspectors

New passenger coach shop of the C. M. St. P. & P. at Milwaukee, Wis.

Milwaukee

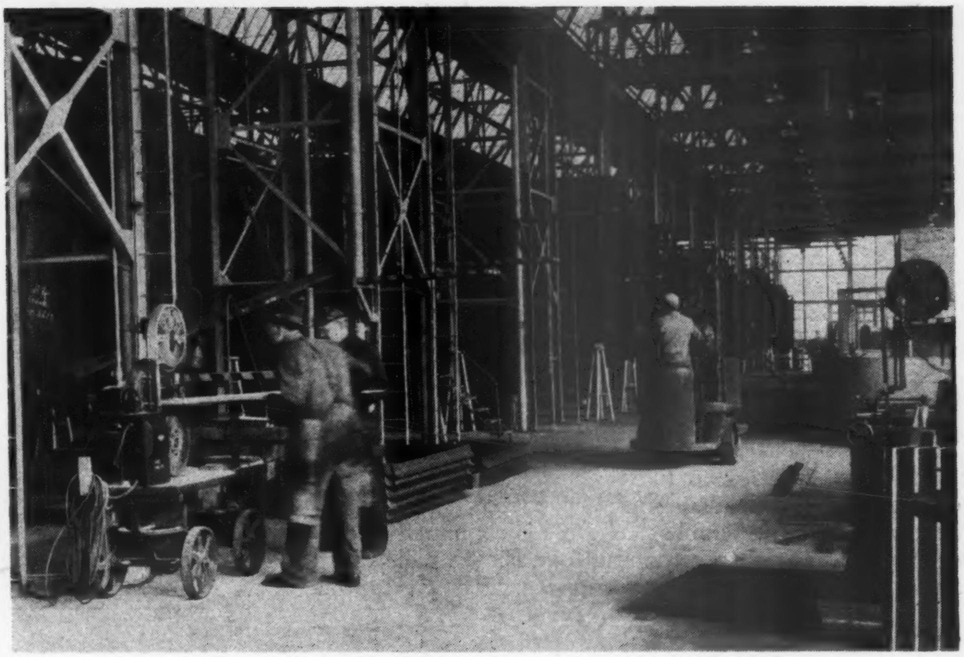
Passenger Coach Shop

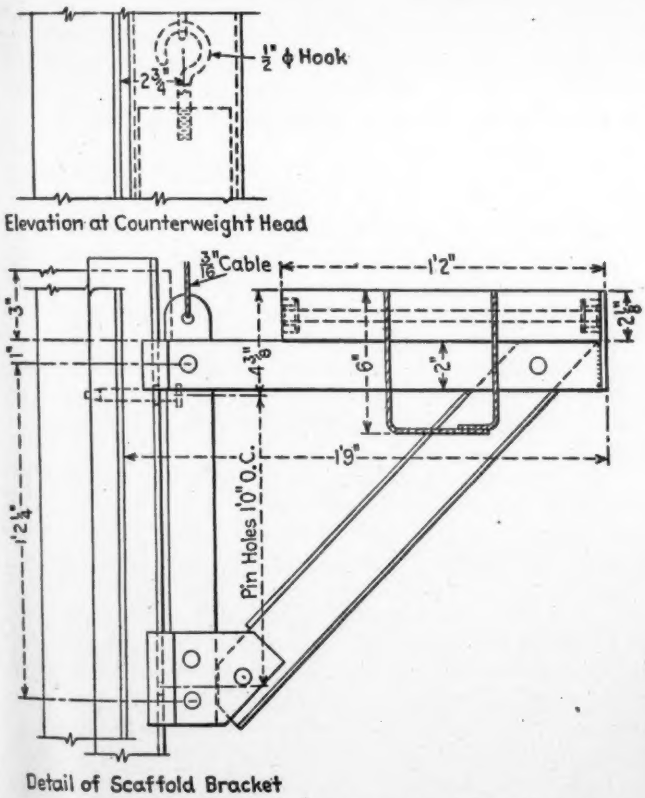
To accommodate the concentrated general passenger-car repair and new building programs now being carried on at the Milwaukee, Wis., shops of the Chicago, Milwaukee, St. Paul & Pacific, the large steel fabricating shop with its modern welding facilities, constructed a few years ago has recently been supplemented by a well-equipped new coach shop for car finishing operations and another shop for repairing old trucks and building new ones. The new



Steel "towers" support the roof and adjustable scaffolds

The office, machines and material storage are located along the side of the building at the ends of the tracks





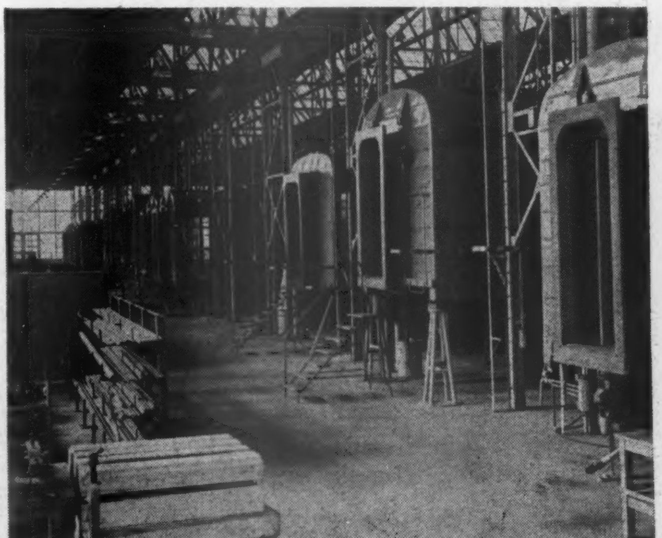
Cross-section of bracket and reinforced three-piece scaffold board

coach shop was also required because of the necessity of providing longer tracks for modern 85-ft. cars and a 40-ft. wide working space, or bay, at one end of the tracks which greatly expedites coach-shop operations and reduces trucking.

The new coach shop building is about 136 ft. wide by 316 ft. long, located just across the transfer table from the older coach shop and equipped with 14 single-car tracks spaced 22 ft. on centers, the track at the east end having a pit to facilitate inspection and other work underneath cars. The roof of this shop is of the saw-tooth type, made of pre-cast concrete slabs and having all of the inclined window areas facing north. This roof is supported with a clear inside height of 24 ft. 5 in. on light structural-steel towers, as shown in the illustrations, instead of the usual heavy, single-column center posts, and these towers also serve as guides and supports for the adjustable scaffolding. Further advantages of this construction include simplification of the overhead steel structure, greater ease of erection, a saving of over 20 per cent in the amount of steel used and the fact that power lift trucks can operate in the aisles between cars, owing to the elimination of center posts.

The towers are made of 8-in. by 8-in. angles set vertically at the corners of 6-ft. squares and suitably cross braced. The squares are spaced 24 ft. on centers, lengthwise of the tracks. The saw-tooth roof construction, in conjunction with large areas of glass in all walls, gives excellent visibility under normal daylight conditions and on dark days or at night artificial light is supplied by overhead drop lamps. The shop is heated by overhead unit-type heaters, located to warm the shop air without directing blasts where men may be working.

Centrally located along one wall in the open bay of the shop is a light office, toilet room, tool room and lunch and locker space. One corner of the open bay is equipped

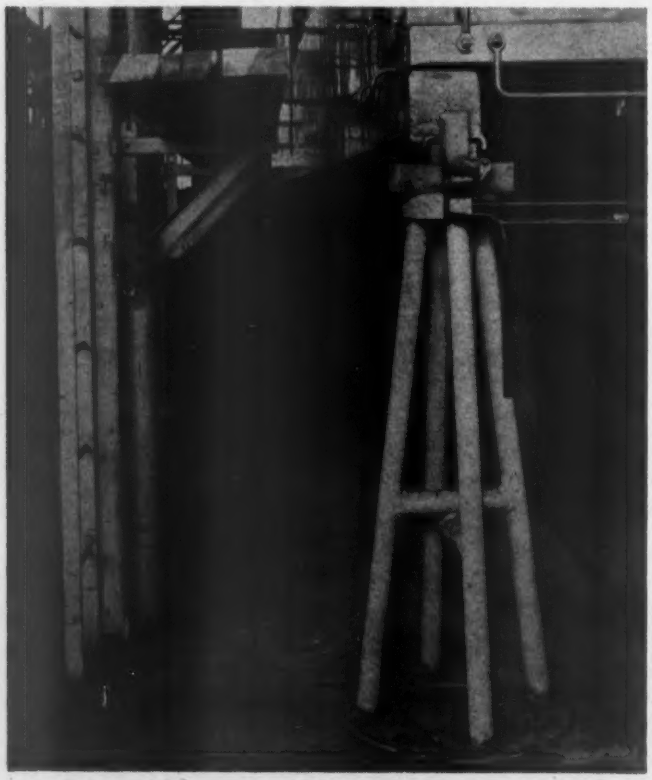


Another coach shop interior

with a brake and shear for sheet-metal work. Other small tools, including a drill a portable metal-cutting band saw and a portable welder, are installed. Lift trucks and trailers operate easily on the smooth shop floor and greatly facilitate material handling.

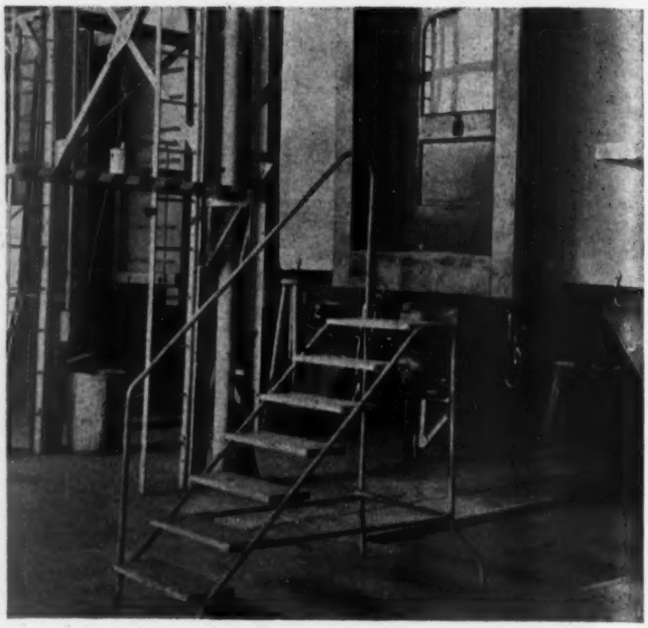
A feature of this shop is the unusually light, but stiff and strong scaffolding which is counterbalanced to 100 per cent of its weight and may be easily moved up or down on the steel towers with one hand and positioned by pins inserted to hold it at any desired elevation. The scaffold on each side of each track consists of three sections, one 32 ft. 2 in. long on each end and one 23 ft. 10 in. long in the center.

Each scaffold section is supported by two brackets, made as shown in the drawing with the usual sliding attachment to a T-iron bolted to one corner of the tower. To the same corner angle, a 5-in. seamless steel tubing, 19 ft. long, is clamped to serve as a housing for the counterweight which is 4-in. steel bar of the required length. A 3/16-in. flexible steel cable is connected at one end to the bracket, passes over a 6-in. sheave pulley just above the 5-in. steel tubing and thence down to the counterweight which is thus completely enclosed at all times and can present no hazard from falling. The maximum height to which the scaffold may be adjusted is 14 ft., as fixed by stops welded to the T-iron supports. Light steel ladders bolted to the towers give access to the scaffolds at any elevation.



A light, tubular steel horse used in supporting car bodies

The stiffness of scaffold boards is secured by means of construction shown in the drawing. Each board is built up of three pieces, 2⅛ in. thick by 4½ in. wide and of the required length, held securely together by ½-in. through bolts. A two-piece U-shape steel stiffener 4½ in. wide by 6 in. deep, is built into the scaffold board and extends the full length between scaffold brackets. This construction, using ⅛-in. steel for the stiffener, adds little to the weight of the scaffold board which has practically no spring or deflection even with two heavy men standing together near the center. Other features of interest at this shop include all-welded metal horses used to support car bodies when the trucks are removed and a light but strong safety stepladder which gives easy access to car end doors. These items are shown in two separate illustrations.



A safety metal stepladder gives access to car end doors

The horse is 53 in. high and consists of four pieces of 2½-in. extra-heavy pipe welded at the bottom to a ½-in. by 24-in. circular plate and at the top to a ½-in. by 10-in. circular plate which has a ¼-in. by 1½-in. steel band welded around the outside to enclose a cylindrical wood block interposed between the horse and the steel car frame. Two cross braces welded between the pipe legs at a point slightly below the middle serve to stiffen the horse which is not only light and easily portable, but amply strong enough to support the load with a substantial factor of safety.

The main frame and hand rail of the safety step ladder, shown in one of the illustrations, is made of ¾-in. pipe and the cross braces and tie bars of ½-in. pipe, welded together in another light but strong unit construction. There are seven steps in the ladder, 8 in. wide by 24 in. long and with a 6¾-in. lift. The width of the top board is 11 in. All steps and the top board are made of wood bolted at the ends to angle-iron supports which are welded to the steel ladder frame. (A description of the new passenger-car truck shop will appear in a subsequent issue of the *Railway Mechanical Engineer.*—Editor)

A Box Car "Gets Around."—Union Pacific research into the movements of one box car over a period of four and one half years has revealed the following data on car No. 193346: It passed through the hands of 83 different railroads, some as many as 10 times, for a total of 221 changes; it averaged a change every seven and one half days; it had been in every state at least once, in several Canadian provinces, and in every major city of the United States; and its loads ranged from boxes of ammunition to canned peas to oil drums. The road stated that car No. 193346 was chosen "since it represented a perfect nonentity among rolling stock, being neither old nor new, neither the best nor the worst. It was a 'John Smith,' the big red messengers that run the nation's errands."

"The Human Side of Railroading," a printed publication of the Association of American Railroads, explains the meaning of "working on the railroad." It is full of information about railroading and tells what is appealing about each job.

Reclaiming Car Materials*

By G. A. Goerner†

THERE is something fascinating about reclamation of material. During depression years, when looking for opportunities to make savings for the railroads, the scrap pile was often overlooked. At times it is a veritable gold mine. True, it takes effort and thought to reclaim items from scrap and make them fit for further service. At times there is more work connected with this than in the manufacturing of new material; but if a saving can be made or equipment put into service, that may otherwise be laid up, it is a profitable undertaking.

A carpenter who remodeled a part of our home said that he would much rather work with new material and build something new from the ground up than to do remodeling. He said that it took so much more effort and thought to do the rebuilding with old materials. So it is with much material that is reclaimed. There are many questions that must be answered to make certain that the work will bring the desired results and, at the same time, prove worth while economically. Some of these questions follow:

1—Is it economically sound and a saving to the railroad?

2—Will the reclaimed item serve as well as new material?

3—Will the reclaimed item meet A.A.R. requirements?

4—Is the material actually required?

The first question relating to the cost of the reclaimed item, is something the reclamation plant must check constantly. During normal conditions, when new material may be had without difficutly, the reclamation plant operates entirely on a basis of the savings made in reclaiming old material. If the labor and added material to reclaim an item, plus overhead, less the scrap value of the item if it were not reclaimed, is higher than the cost of new material, the old material is scrapped and not reclaimed. In the overhead per cent, we include every cost in the operation of the plant itself, such as investment in machinery, interest, taxes, electricity, light, heat, supervisory and clerical forces.

There are times, however, when it is not entirely a matter of economy but of necessity that reclamation is done. During the war there were many items of material unobtainable from dealers. It was not a matter of reclaiming such items to save money but to get the material, even though the cost was equal to or even somewhat higher than the new material. In emergencies this may be expedient at any time.

The question of serviceability of the reclaimed item is an important one. The expected life of the reclaimed item is also an important factor when determining the economy of reclamation. If it is material that will not produce as good results nor wear so long as new material, these facts must be considered when determining the economy of reclaiming it.

Whether the reclaimed item will meet A.A.R. requirements is something that applies with special emphasis to car material. Therefore all work at the reclamation plant is checked from that angle so that all reclaimed material to be used on cars in interchange meets these requirements.

Material is reclaimed only on orders from the store. Unless the material is required for immediate use or for regular stock, no orders are made for it. Therefore nothing is reclaimed ahead that would not be purchased or manufactured if the reclamation plant did not exist.

We maintain stock records, indicating the quantity of each item on hand for reclamation, as stock information so we know what we can depend on, but no money is spent on this material until it is needed for use or for stock at the store. Such an arrangement avoids investing the railroad's money further in advance than necessary. It also prevents reclaiming of material that may never be used.

* Abstract of a paper presented at the March 10 meeting of the Car Foremen's Association of Chicago.

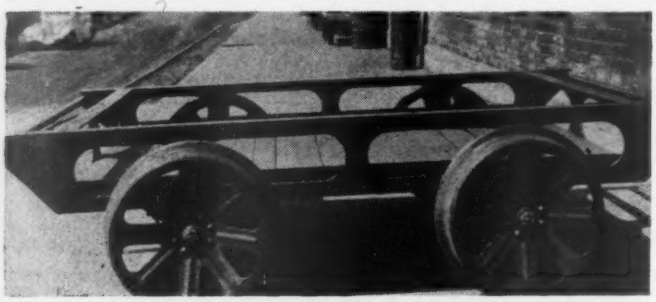
† General storekeeper, Chicago, Burlington & Quincy.

C. B. & Q. scrap yard at Eola, Ill., where all system materials to be reclaimed are sorted and delivered to the reclamation plant

What Is "Reclamation"?

But what is reclamation and what is the difference between reclamation and repairs of material? Webster defines "reclamation" as: "the act of making industrial waste products useful". To reclaim, then, it is not necessary to bring the item reclaimed back to its original condition so that it will equal its former state in usefulness or length of service; it is only necessary to make the waste product "useful". This waste product may even be reworked, reshaped or converted into something entirely foreign to its original use. So long as there has been a profitable or advantageous conversion of the scrap item, the process of doing this is reclamation.

However, many items of material are reclaimed to their original state of usefulness, so that their second and third service is just as effective and as durable as their first life was. It may require some welding, a bushing or some new wearing parts to get such results, but the fact is that they are obtained.



Light push car made from scrap materials

Moreover, reclamation of some items is done in such manner that the reclaimed item will serve even better and longer than when it was new. That may sound fantastic. Nevertheless, it is true. At no place are defects in material, weak spots in design, or unusual wear and breakage any more detectable than at central scrap docks where material is checked for possibilities of reclamation.

But you are interested mainly in reclamation of car material. So I will list a few of the items of car material that are reclaimed from scrap, repaired or reworked at our reclamation plant, and will tell you briefly what procedure is necessary to make a few of these serviceable.

I would like to have you note especially that every effort is made to produce material that will go back into service in the best possible condition to give good service. When centralized reclamation was started on the Burlington under the supervision of the stores department, there was some skepticism on the part of some car men and mechanics when using reclaimed material.

Because it was secondhand, they thought it was not fit for service. We had to polish and paint many items so they looked like new in order to get them into service. Several tests proved the psychology of this. Items that were rejected were simply painted and returned to the party making the complaint with the request, "Please try these and let us know how they serve", and the reply would read, "These are good; nothing wrong with them."

Unnecessary painting and polishing has been discontinued and since our laboratory inspects material reclaimed, there is no longer any question as to its serviceability in the minds of the user.

As bad-order brake beams are removed from cars on repair tracks, at the car rebuilding shop and from dismantled cars, they are shipped to the reclamation plant. As much as practicable they are kept separate from other material and from scrap to facilitate unloading on arrival at Eola and to avoid damage in shipment.

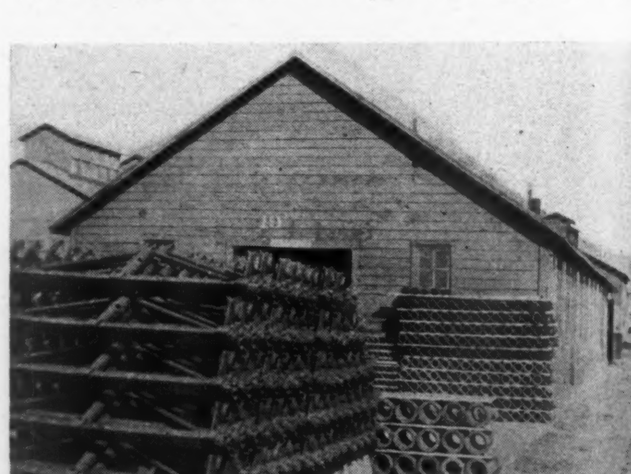
The reclamation process really amounts to a rebuilding of the beams. The first operation is that of stripping the beams by cutting the truss rods on a No. 3 shear. At one time an effort was made to reclaim the truss rods, but this was found to be unprofitable since many rods are badly worn and not fit for further service. The old rods are now used for manufacture of machine bolts and brake pins. The cutting of the truss rods also saves labor in stripping inasmuch as the removal of the brake heads, struts and channels is made easier than where the entire rod is salvaged.

As the parts are removed they are placed in separate containers, made from old boiler shells, for delivery to the shop for reclaiming. Here the channels are heating and straightening on a bull-dozer. The channels are then gaged for thickness and length. Those which do not meet specifications are used for manufacturing of safety straps.

New steel is used in the manufacture of truss rods. The bars are cut to length, threaded and formed to the required shape on a bending machine.

The struts are reclaimed by building up worn spots by the oxy-acetylene process. This is done so that the brake-pin fit is satisfactory without the necessity of reaming the hole. The brake-pin hole is built up with bronze welding rod. Any struts that are bent are straightened. The assembling of struts to the channels is done on a home-made bucking machine which holds the channels and the struts.

Worn spots on brake beam heads are built up by the arc-welding process. This provides a hard wearing surface. This is an illustration of what is meant by reclaiming material so the life of the reclaimed item is longer than the life of the new material. The four outer lugs and the two center lugs are built up, provided the original stock is not worn to less than 1/8 in. in thickness. After the welding process, all heads are ground with a portable grinder to fit gauge.



Brake beams and springs which have been rebuilt and reconditioned for further service

The assembling of the reconditioned parts into a complete beam is done on a specially designed assembly table which holds the channel solidly in place. The rod is placed in the proper position and the struts and heads applied. The beam is then held together by the application of unit grip nuts. An air motor is used to apply the nuts. This provides the necessary power and speed for a satisfactory operation.

The assembled beams are than gauged for required height and length and tested on a hydraulic testing machine at 15,000 lb. pull on the strut. While the test is

in process, the operator strikes each head two solid blows with a hammer to take up the slack in the assembly. After they are tested, the beams are again checked for height and length.

Beams which meet the final test are daubed with a spot of white paint to indicate that they are repaired beams. Any beams not passing the final test are reworked so they will meet these requirements. However, it is a rare occasion that a beam does not come up to specifications, for the method used in rebuilding them is such that there should be little difficulty with them competing with new brake beams.

Reclamation of Coil Springs

Coil springs, like brake beams, arrive at the central scrap dock from all car points on the railroad. They are sorted by size and placed into box skids for convenient lift-truck movement into the spring shop.

The first move toward spring reclamation is to get the springs into the furnace for heating. At the start the furnace is charged to capacity (about 40 springs of average size) and is recharged whenever half of the springs have been removed. This provides for a constant supply of springs for reworking, saving delay to the operation, waiting for springs to reach the proper temperature. The furnace temperature is 1,800 deg. F. The springs remain in the furnace for 30 min.

As the springs are taken from the furnace, they are spread to proper height. The outer coils are spread on a special spring reformer; all others are spread by hand with tongs.

After the springs are reformed, they are tempered on a special machine which was built at the Eola plant and patented by one of our foremen. The machine consists of a large wheel equipped with 16 swivel buckets 10 in. wide, 15 in. long and 6 in. deep. Each bucket holds one spring. The wheel is motor driven, running clockwise. The wheel carries the springs which have a temperature of about 1,600 deg. F. down into a vat of tempering oil.

The movement of the wheel is synchronized so that the springs are held in the tempering oil the required time to get best results, then the springs are automatically dropped from the buckets as they emerge from the oil. The tempering tank holds 2,500 gal. of oil, which is circulated through pipe coils to keep the oil cool. The operation from the time the springs are placed into the buckets until they are deposited at the opposite side of the wheel requires from 2 to 4 min., depending on the size of the springs.

After the springs are cool, they are tested on a hydraulic testing machine. They are closed three times under the pressure of this machine; if then they do not measure to corret height, they are scrapped because the life of the steel has been exhausted.

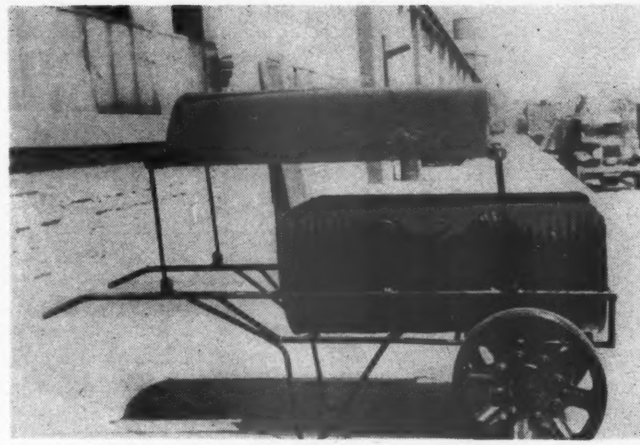
Brake Shoes and Journal Boxes

New brake shoes are applied to passenger cars in main-line through train service. When these shoes are worn to a given limit, they are removed and used in suburban service. When worn to a lower specified limit, they are still serviceable for system freight cars.

All brake shoes arriving at the scrap dock are carefully inspected. Those with sufficient wearing surface are set aside and re-used to the best advantage on system cars.

Before journal boxes are brought into the welding shop, they are placed on furnace table and sufficient heat used to burn off all refuse. The boxes are then moved into the welding shop where they are sand-blasted. This procedure makes all cracks visible.

On malleable iron or cast iron any area affected by



Journal-box-packing cart made from an old oil drum—Note removable cover

flame cutting is thoroughly removed by chipping or grinding. This is important since malleable iron, when heated to a molten state, reverts to cast iron from which it was made through a long heat-treating process.

The box is then reclaimed by building up all worn surfaces with bronze. Because of the tolerances permitted in the journal, wedge, brass, and box, it is important that this work be done accurately.

The lid must fit properly. The proper building up of the crown is also important to permit proper seating of the wedge.

Couplers, Bolsters and Truck Sides

Cracks or fractures in couplers, cast steel bolsters and truck sides are cut out with a cutting torch, chipped or ground out so no portion of the crack remains. The surface upon which new material is to be deposited must be clean and reasonably smooth. If the surface is prepared by flame cutting, the oxide scale must be removed before the welding is started. The casting is then ready for welding. The weld must be finished so as not to create a notch or an abrupt change in the thickness of the section so welded.

Worn surfaces are built up with welding metal. These surfaces must be prepared for welding by cleaning and making them reasonably smooth. Excess metal is dressed down to the proper casting dimensions.

The castings are heat-treated after welding. They are uniformly heated and cooled for annealing, normalizing or stressing-relieving. The annealing and normalizing is done at a temperature of from 1,500 to 1,600 deg. F. the stress-relieving from 1,200 to 1,250 deg. F.

The following is a list of car parts reclaimed by welding, brazing and building up worn surfaces: Center plates, side bearings, cast-steel yokes, truck columns, brake-beam heads, brake-beam fulcrums, journal boxes, journal-box lids, draft lugs, door fixtures, truck sides, couplers, knuckles, bolsters floating levers, floating-lever connections, draft gear castings, lugs and flanges on brake cylinders and reservoirs, and worn or broken-out holes on triple valves.

Many items of car material are reclaimed from scrap requiring no work. Such parts are simply inspected to make certain they are in good condition and not worn beyond reasonable limits. Among these are: Safety straps, brake hangers, follower plates, draft gear keys, spring plates, side bearing shims, retainer keys, knuckle pins, coupler parts and many other castings and forgings.

The reclamation plant also manufactures from scrap materials such items as machine bolts, brake pins, gusset plates and corner pieces.

Improvements at the

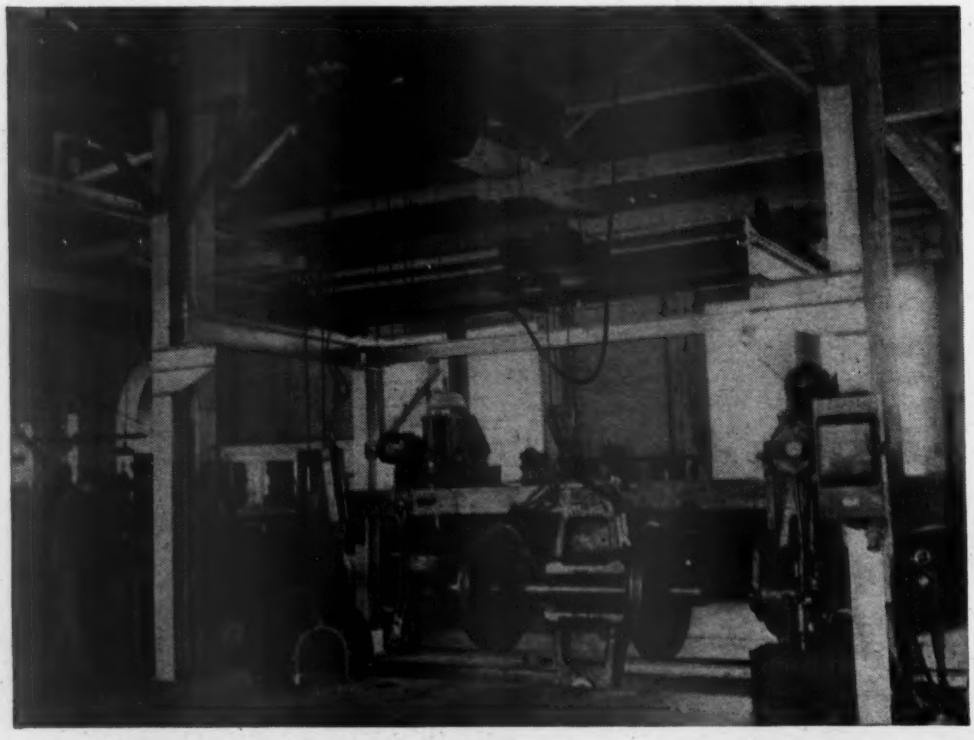
D. & R. G. W. Wheel Shop

By Charles Eisele*

THE Denver & Rio Grande Western has recently completed the modernization of its Burnham (Denver) wheel shop to permit handling a wide range of wheel work with a considerable saving in labor. Particular attention was given to the arrangement of machine tools and layout of an overhead handling system to secure straight-line movement of work through the shop, eliminating as far as possible reverse movements and duplicate handling. This shop is depended upon for Diesel-locomotive wheels, steam-locomotive truck, trailer and tender wheels, in addition to its share of the regular chilled-iron and steel car-wheel work.

The shop area is small, approximately 60 ft. by 115 ft., and is equipped with conventional wheel-shop equipment, including a wheel borer, axle lathe, journal lathe, 50-in. wheel lathe, and two hydraulic presses, with space for the later installation of a wheel-tread grinder.

* Shop engineer, Denver & Rio Grande Western, Denver, Colo.



Overhead bridge crane and one end of the monorail serving the wheel press

Below: Monorail system in Denver wheel shop equipped with one three-ton and one five-ton electric hoist

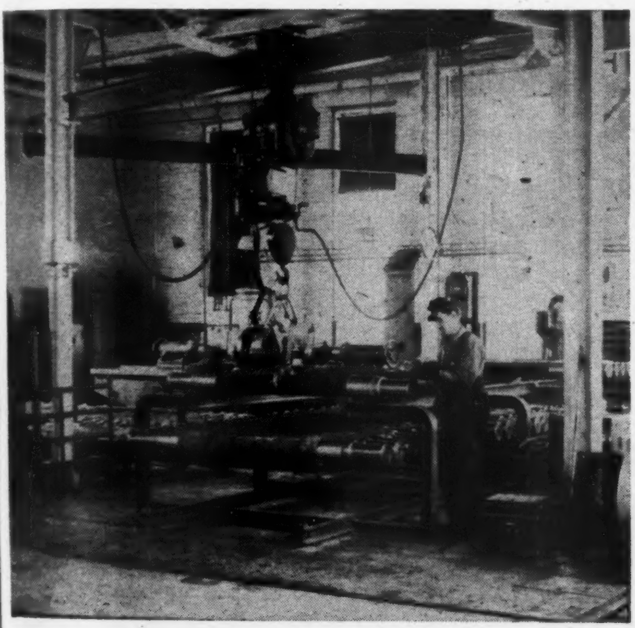
Tool and profile grinders—Inclined wheel press in the background

The limited shop area and large number of different wheels handled, presented quite a problem, as in numerous cases a considerable number of wheels had to be moved to secure the particular pair of wheels desired.

Monorail System Installed

Installation of an overhead monorail system to serve all shop tracks, wheel lathe, journal lathe, and hydraulic press makes it possible to select any pair of wheels in the shop and move them to any machine without disturbing other wheels. This monorail system consists of American monorail electrified MD-1 track with glide-type switches. Two electric hoists are in operation on the monorail, a three-ton and a five-ton Robbins & Meyers equipped with monotractors to propel them along the track at a speed of 100 to 135 ft. per min. The hoists are of the two-speed type, with both travel and lift controlled from a push-button pendant, suspended from the monotractors.

The five-ton hoist on the monorail is required to handle



Three-level axle rack and jib cranes

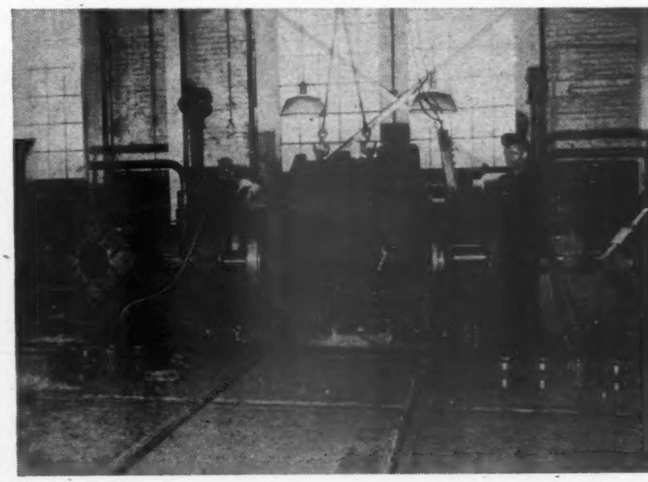
Diesel locomotive traction-motor and wheel assemblies into the wheel lathe for wheel-tread turning. In this handling operation, the low-hoist speed and ability to control travel speed is particularly desirable, enabling the operator to spot these heavy assemblies accurately between lathe centers.

A three-tier axle rack constructed from old rail is located between the axle lathe and the car-wheel press. Axles removed from wheels are placed on the lowest floor-level pair of rails in the rack and, due to a slight incline, the axles roll to the wheel-lathe end of the rack, readily accessible to the wheel-lathe operator. Finished axles are placed in the middle tier (about 18 in. high) by the lathe operator and roll in the opposite direction to be accessible to the operator of the wheel borer for measurements. Axles as they are fitted are placed on the top tier (about 36 in. high) of the rack for Magnaflux testing and thence to the press for mounting. This procedure always places the last axle fit on the end of the top tier closest to the press and within easy reach of the press operator.

This arrangement works out very satisfactorily, as the last wheels bored are at the end of the row and the first to be handled into the press.

Jib and Bridge-Type Cranes

Jib cranes are used at both the axle lathe and the wheel press. The jib crane at the wheel press is mounted directly on the column supporting the monorail and roof



Diesel locomotive traction motor and wheels at the wheel lathe

structure and will swing the full 360 deg., thus serving a large area.

The old remodeled hydraulic wheel press for handling Diesel locomotive wheels and other larger-diameter wheels is installed on a slight angle from the perpendicular to permit handling the wheels and axles with the overhead hoist and not interfere with the upper tension member of the press. This press is served by both the monorail and a bridge-type crane.

A Yale 6,000-lb. capacity fork-lift truck is assigned to the wheel shop and can be used for handling loose wheels with a conventional wheel ram or bar and to transport mounted wheels from shop to coach yard and rip track, two pairs at a time on the lifting fork.

A Davis cutter-bar tool grinder and a Gorham-Baker contour grinder permit fast and accurate grinding of shop tools, including the tread-forming tools.

Car wheels being moved to the boring mill on a Yale fork-lift truck

The details of this modernization program were worked out by the railroad's mechanical and engineering departments. The Denver representative of the American Monorail Company assisted with the monorail application. Installation was made by the railroad's engineering department.

ELECTRICAL SECTION

Strain Gauge Testing

Santa Fe now using portable equipment for measuring forces exerted by trains on track structure and testing locomotive and car parts

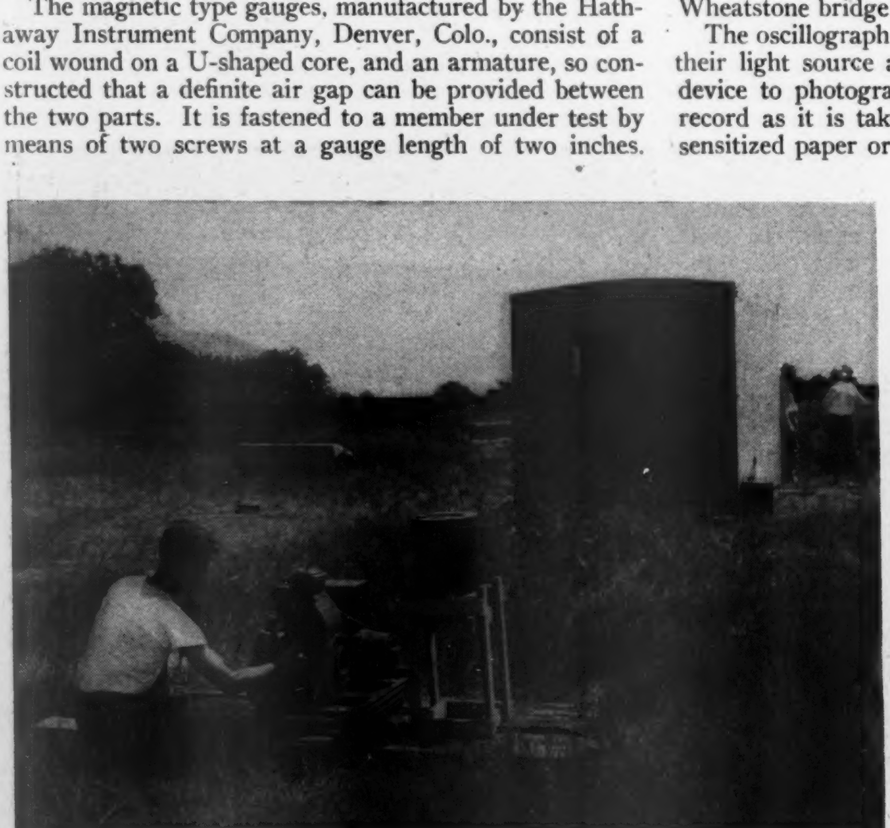
To assure safe operation of high-speed trains, the Santa Fe is now actively engaged in making tests to determine the amount and character of stresses which are caused in bridges and track structure by the passing of trains. The testing equipment will also be used for counterbalance tests, for testing of structural parts of locomotives, cars and trucks while in use, and for torsion tests on axles. In some cases, high-speed motion picture cameras are used to record the position of wheels and counterbalances of locomotive drivers in relation to instruments in making rail and bridge tests. Accellerometer units have also been purchased with which riding qualities of cars may be tested.

The strain gauges used are of two basic types: resistance and magnetic. The resistance gauges used by the Santa Fe are manufactured by Baldwin-Southwark Division, Eddystone, Pa., and consist of grids ¼ to 1 in. in length, made of one-mil, copper-nickel wire cemented between two very thin pieces of paper. The approximate resistance is 120 ohms. This gauge is bonded to the member under test consideration with a plastic cement, its change in length being readily measured by the change in the electrical resistance of the wire.

The magnetic type gauges, manufactured by the Hathaway Instrument Company, Denver, Colo., consist of a coil wound on a U-shaped core, and an armature, so constructed that a definite air gap can be provided between the two parts. It is fastened to a member under test by means of two screws at a gauge length of two inches. The change in length of the member under test causes a change in the length of the air gap and, in turn, a change in the impedance of the coil. These gauges are connected in a conventional Wheatstone bridge circuit, the active gauge forming one leg of the bridge, and compensating or "dummy" gauges being used in the other three.

The electrical strain gauge recording equipment used is built by the Hathaway Instrument Company. It consists of a recording unit called an oscillograph, an amplifier unit which amplifies the output of the gauges to values large enough that they may be recorded on the oscillograph, and a power supply unit which furnishes plate and heater voltages for the amplifiers, and also supplies a 5,000-cycle gauge voltage which is applied across the Wheatstone bridge circuit.

The oscillograph consists of twelve galvanometers with their light source and optical system, a time-coordinate device to photograph accurately-spaced lines across the record as it is taken, and a mechanism for driving the sensitized paper or film upon which the record is photo-



The portable engine-generator set in the foreground supplies power to the amplifier and oscillograph in the test house

Through-girder bridge being tested for stress caused by the passing of a high-speed passenger train

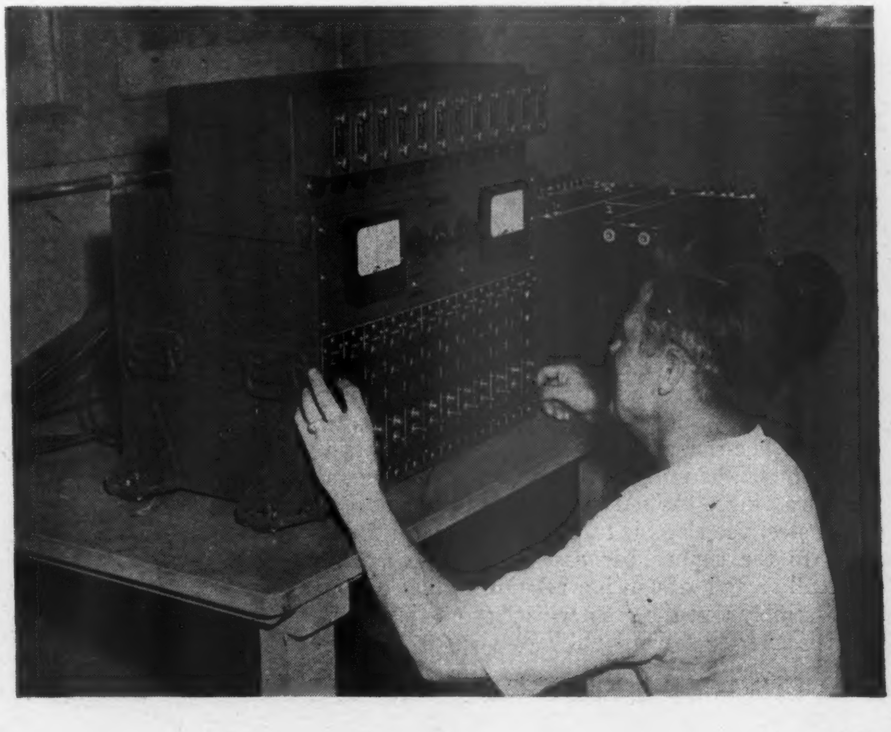
graphed. The power for operating the oscillograph comes from two 6-volt storage batteries

The amplifier or control units contains twelve separate channels. An input cable connector provides for connection to the strain gauge and an output cable connector makes the connections to the galvanometer in the oscillograph. Both resistance and capacitance balancing controls are incorporated in this unit to permit convenient balancing of the strain gauge bridge. The use of the 5,000-cycle gauge carrier voltage is desirable in that both static and dynamic strain may be recorded. The use of a phase-sensitive demodulator is employed in the output circuit, which provides a galvanometer deflection in one direction for strain of extension and in the opposite direction for strain of compression. The amplifier channel permits strain recording over a frequency range of 0 to 1,500 cycles per second.

The power source for the amplifier and control unit is a portable 110-volt, 60-cycle gasoline engine-generator plant of 2,500 watts capacity. This power plant furnishes ample power to operate three power supplies, furnish lights in the test house, and power for battery charging and testing instruments.

The bridge shown in Fig. 1, near Topeka, Kan., was selected as the first of a series to be near the test laboratory for machine shop and test facilities. The next one was a through girder type bridge near Galesburg, Ill., crossing another railroad at a 45-deg. angle, which had been in service some years. There was concern that some reinforcing or rebuilding might be necessary, but careful check showed that stress values were so well within accepted figures that it eliminated the need of changes and permitted turning attention to other needs. The next bridge tested was a truss span at Eudora, Kan. The stresses recorded at very high speeds were of a value which approached the allowable values used by the bridge department, and it was deemed advisable to put a restricted speed order on this bridge.

The instrument at the left amplifies the weak signals coming from the bridge and rails and the amplified signals are recorded by the oscillograph shown at the right



Maintenance of

Railway Motor Commutators

By R. E. Kelly*

What the man in the shop should know about commutator design and procedure required to keep commutators in serviceable condition

Fig. 1—Tightening a disc-spring design railway motor commutator in a hydraulic press—As pressure is applied, the nut is tightened by turning the special internal keyed wrench with its handle through a slot in the pressure ring

MAINTENANCE of commutators can be facilitated by an understanding of the railway motor construction features most frequently involved in maintenance operation. A commutator, being an assembly of parts, performs satisfactorily only as long as all of the parts stay in the same mechanical location with respect to one another. A movement of a few bars with respect to the other bars leads to roughness, sparking, and rapid wear. To prevent such movement, it is essential to keep the commutator tight enough so the relative motion of any part is held to a minimum.

Railway commutators, and most industrial motor commutators, are of the vee type. In each end of a set of copper bars and insulating mica segments, there is machined a vee-shaped groove. This groove fits the corresponding inverted vee shape of the steel rings and of the mica rings. When assembled, the pressure applied to the steel vee rings is transmitted through the mica vee rings to the copper bar assembly. The machining of the steel parts bears such a relation to that of the copper bar assembly that the greater part (sometimes all) of the force is exerted toward pulling down on the lower side of the vee groove and keeping the copper bars archbound. The remaining force exerts a relatively light pressure at the upper side of the vee groove, near the end of the copper overhang, to make firm contact against the

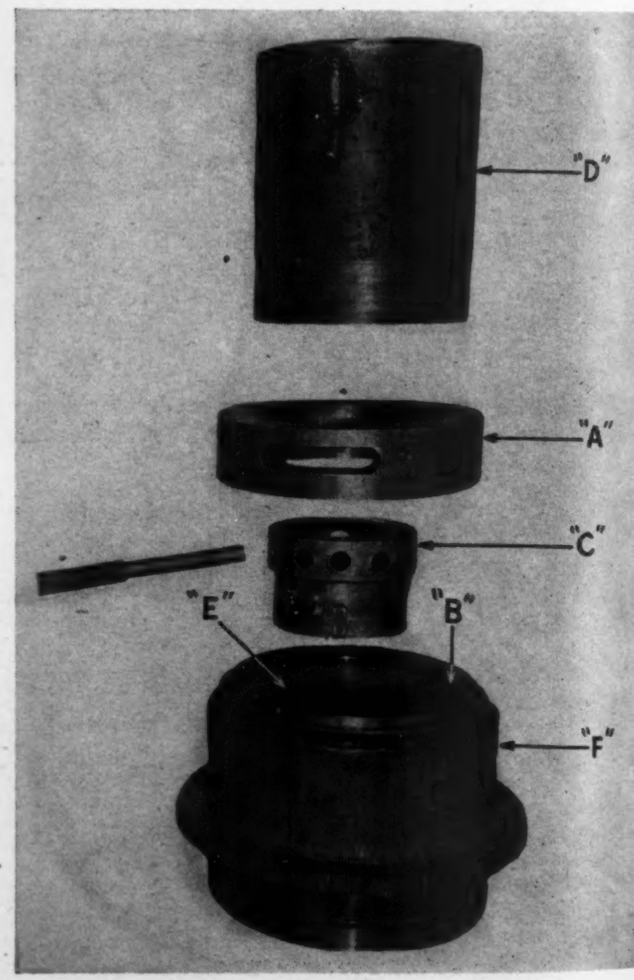


Fig. 2—Tools for tightening disc-spring design railway motor commutator—*D* is a cylinder which transmits the force of the hydraulic press to the pressure ring *A* and disc spring *B*—The pressure ring is machined in such a manner that the full force of the press is applied to the inner diameter of the upper face of the disc spring, thereby causing angular deflection—As pressure is applied the bar for wrench *C* is inserted through the slot of pressure ring and then turned—The keys on wrench *C* engage the keyways inside the commutator nut *E*—The copper commutator bars are identified by *F*

* Transportation Engineer, Transportation & Generator Division, Westinghouse Electric Corporation, East Pittsburgh, Pa.

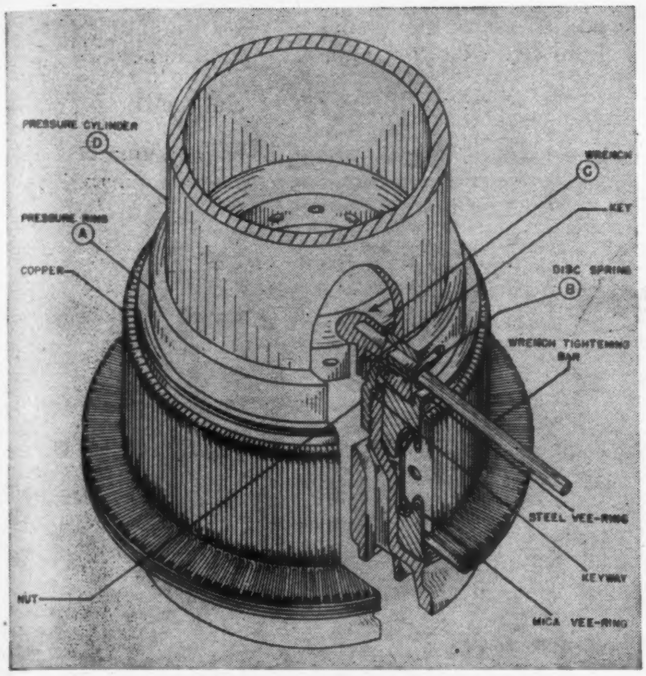


Fig. 3—Schematic drawing of Fig. 2—All parts are labeled to correspond with Fig. 2

mica vee ring and to seal out dirt and moisture. In those particular designs where all of the force is applied to the lower side, and none at all at the upper side, the remaining gap at the upper side is sealed externally to prevent the entrance of dirt and moisture. Such a commutator is completely arch-bound.

The resulting structure is in reality a combination of springs, the most elastic member of which is the mica between the copper bars. Any change in conditions, such as speed or temperature, is reflected as a change in distribution and magnitude of the various forces inside the commutator. This concept of a commutator being a combination of springs is very helpful in analyzing the stresses that are developed in the various parts.

The problems that arise in maintaining railway type commutators are similar to those that arise with other types, but there are some differences in important details. One difference is the operating temperature. All commutators are affected by changes in temperature, as their various parts; steel, copper and mica, all expand at different rates. These differences in expansion rates result in higher internal stresses with higher temperatures. Since railway machines are, of necessity, operated rather hot, and with many cycles of operation from low to high temperature, the extra expansion resulting must be taken into account in the design. Of the three principal designs of commutators, the disc spring can handle the most expansion, the bolted next, and the ring nut the least. This significant advantage has led to the use of the disc spring design in some of the larger high-speed traction motors.

Another difference is speed. Railway commutators must operate over a wide range of speed, from the starting condition clear up to the maximum speed. Such a range is normally covered many times each day in railway service, as contrasted to some industrial applications where the motor is started only once a day, and then runs steadily. The trend in design of railway motors has been, and continues to be, toward higher speeds as a means of meeting space limitations. The result of this trend is that commutators in railway applications are now required to run at higher maximum speeds than most commutators in industrial service. The centrifugal forces resulting from these higher speeds are reflected, in the design of modern commutators, by larger and stronger steel parts, shorter copper overhangs, and higher initial assembly pressures.

These changes in commutator design, in turn, affect the maintenance program, for such operations as pressing and tightening are obviously different for a disc spring than for a bolted commutator.

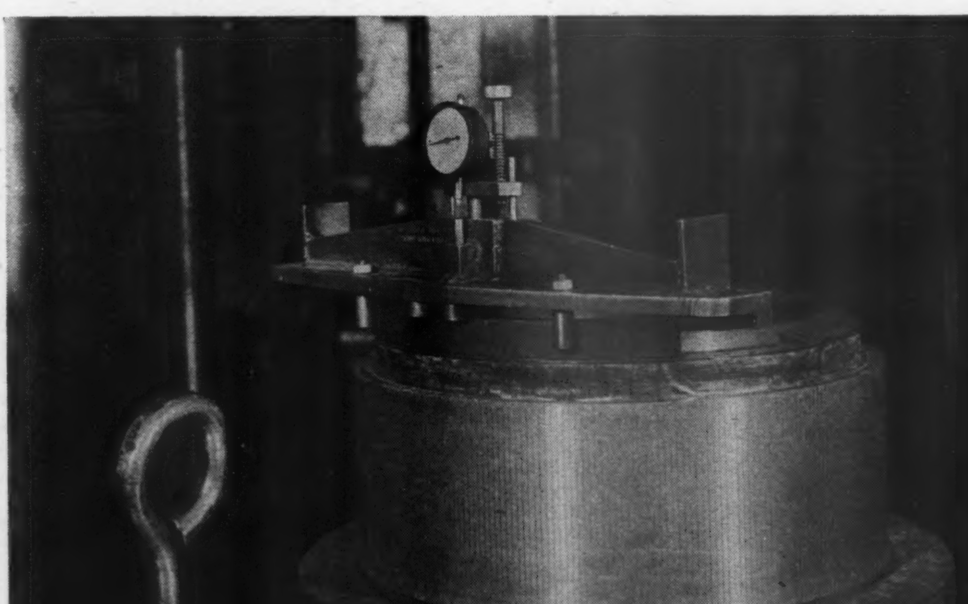


Fig. 4—The amount of pressure on a disc-spring design railway commutator is determined by measuring the angular deflection of the disc spring

Tightening Railway Commutators

In maintaining traction motor armatures, it is sometimes found necessary to tighten commutators which have become loose after long service. Usually, the tightening operation requires the use of special tools. A general idea of these tools and their use can be obtained from the accompanying illustrations. It will be observed that many of them are of such a nature that they can be readily produced in a shop.

The method of tightening a Westinghouse disc spring railway commutator in a press is shown in Fig. 1. In Fig. 2, are seen the individual parts. This commutator can only be tightened by applying a tremendous pressure to the spring while rotating the nut. Referring to Fig. 2, the ring "A" is made with a machined face which applies pressure to surface "B" on the disc spring while still allowing a bar to be inserted for turning the wrench "C." The keys on wrench "C" engage corresponding slots in the commutator nut "E." The hollow cylinder "D" transmits the pressure to the ring "A." Fig. 3 shows the relation of the parts schematically.

Fig. 4 illustrates a method for determining the pressure on a commutator by measuring the angular deflection of the disc spring which is calibrated for such measurements before assembly.

Fig. 5 illustrates a method for tightening a bolted commutator while Fig. 6 shows how this type of commutator is tightened when on a completed armature. In each case, the pressure is applied to the vee-ring at points between the bolt heads so these are accessible for tightening with a wrench. An indicating torque-wrench is used so that a predetermined torque can be applied to each bolt. In tightening such a commutator, the best results are obtained by tightening alternately bolts which are diametrically opposite each other rather than proceeding continuously around the circle. It is recommended that the tightening be repeated until the bolts do not move when the correct torque is applied.

Fig. 5 — Special machined spider is used to transmit the pressure of the hydraulic press to the vee ring while bolts are tightened with an indicating torque wrench

Assembling a Set of Segments

It sometimes happens that a set of commutator copper and mica segments is no longer fit to use, whether as a result of wear or of burning, while the steel parts are still sound. If a set of copper is worn to nearly the condemning limit, and a complete new armature winding is needed at the same time, then the copper should be discarded for the reason that it is not economically sound to leave doubtful commutator copper with good armature windings. There is too much risk that the commutator will be soon worn down and force the scrapping of the armature windings.

When it is necessary to refill a set of good steel parts with a new set of copper, it is always recommended that the job be done at the factory to insure the best results. However, conditions sometimes make it impractical to do so and the decision is made to apply a new set of assembled segments in a railway shop. When this is to be done, the following steps are recommended.

1—Stand the commutator or armature on end and place the set of assembled segments, held by banding wire (or clamp rings), in position on the rear of the vee ring. The proper position for the segments requires checking the alignment of bars with the armature slots in a number of places and averaging whatever variations are found. Then place the front mica vee ring, steel vee ring, and nut (or bolts) in position. Tighten, but only enough to barely hold the parts together.

2—Tie two pieces of cotton tape around the assembled segments, one above and one below the banding wire. (Note: This is not required if adjustable clamp rings are used instead of banding wire.)

3—Cut the lower banding wire.

4—Take up the slack by tightening the commutator

nut (or bolts). Rap lightly on the steel vee ring with a rawhide mallet, but do not force the vee ring while the assembly is cold, for the mica vee ring may crack while the commutator is cold.

5—Cut the upper banding wire and again take up the slack. Remove the cotton tape.

6—Check the alignment of the commutator bars to be sure they are parallel to the armature slots or to the shaft.

7—Tighten the commutator nut (or bolts) just snug with a hand wrench.

8—Heat the entire assembly in an oven,—150 deg. C. is a desirable temperature, provided the armature windings are known to be safe at this temperature.

9—While still hot, apply the pressure specified for the particular type of commutator and tighten. Cool and tighten again.

10—Repeat Nos. 8 and 9 until the movement of the nut or bolt heads becomes less than ¼ in. as measured at the periphery. (Note: A set of assembled segments may sometimes bind on the outer (or 3 deg.) angle instead of the lower angle before the banding wires are cut. This should not cause any worry, provided the commutator segments close in properly after the tightening and baking is finished.)

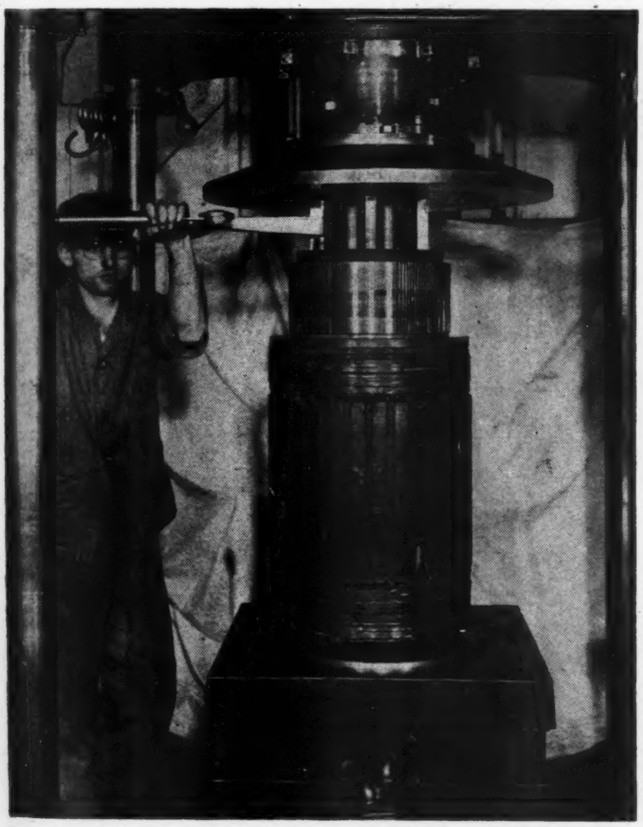


Fig. 6—Special machined spider for use when a commutator is attached to an armature—The armature spider rests on a special tool to prevent the coil ends from being damaged—To apply predetermined pressure an indicating torque wrench is used

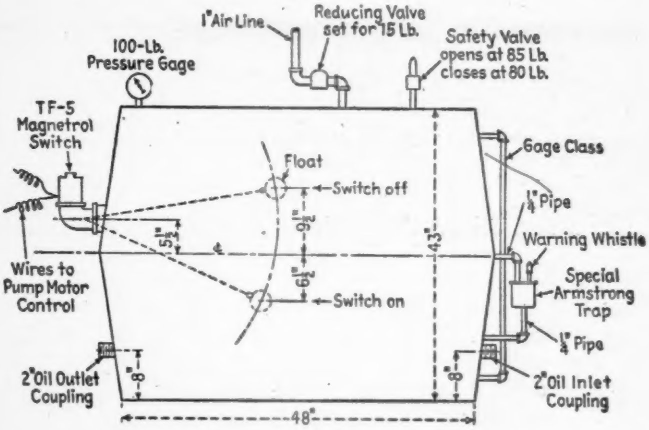
Allowable Wear

After a commutator has been in use for a long period, its diameter has been reduced because of brush wear and because of the removal of copper every time the surface is machined, ground, or sandpapered. Eventually, it reaches a point where it can no longer be safely operated and must be discarded. To delay this as long as possible, it is recommended that grinding be done only when necessary, and with care to remove a minimum amount of material. The safe limit of wear for any commutator can be learned by inquiring of the manufacturer, if it is not found in the instructions supplied with the machine.

Constant Pressure Diesel Lubricating Oil Supply

A lubricating oil supply system which assures oil at constant pressure and which requires operation of the oil pump motor only at long intervals is used in the Diesel-electric locomotive repair shops of the Denver & Rio Grande Western at Denver, Colo. Instead of requiring the pump motor to start and stop each time there is a demand for oil, the oil is pumped periodically into a pressure tank from which it is drawn off as required. No oil by-pass is required.

The cylindrical pressure tank which is placed horizontally is 48 in. long and 43 in. in diameter. Pressure on the surface of the oil in the tank is obtained from the shop air lines through a reducing valve which supplies pressure at 75 lb. per sq. in. As oil is drawn off from the tank, the float is lowered on its arm (24 in. arm) until it is 6½ in. below the center line of the tank, a constant pressure being maintained through the reducing valve. At this point, the Magnetrol switch closes causing the 5-hp. pump motor to start. The pump then delivers oil from a supply tank to the pressure tank until the float reaches a point 9½ in. above the tank center line. At this point, the Magnetrol switch opens and the pump motor is stopped. Approximately 200 gallons of oil can be drawn from the tank in varying amounts before the main pump operates.



The float valve controls the pump which delivers oil to the tank and the reducing valve and safety valve keep the tank pressure constant

While the tank is being filled, the air space in the upper part of the tank is reduced. This tends to increase the pressure but the pressure is relieved at 85 lb. by the safety valve. When the oil level is again lowered by the drawing of oil, the pressure is sustained by the admission of more air through the reducing valve.

To avoid the possibility of admitting air to the oil outlet pipe, in case the motor should fail to start, the special Armstrong trap admits air to a warning whistle when the oil level reaches a point close to the outlet coupling. A gauge glass and a pressure gauge give visual indications of the oil level and the pressure in the tank.

The tank was designed by and installed under the supervision of J. H. Whipple, Jr., superintendent Diesel equipment, Denver & Rio Grande Western.

Induction Pinion Puller

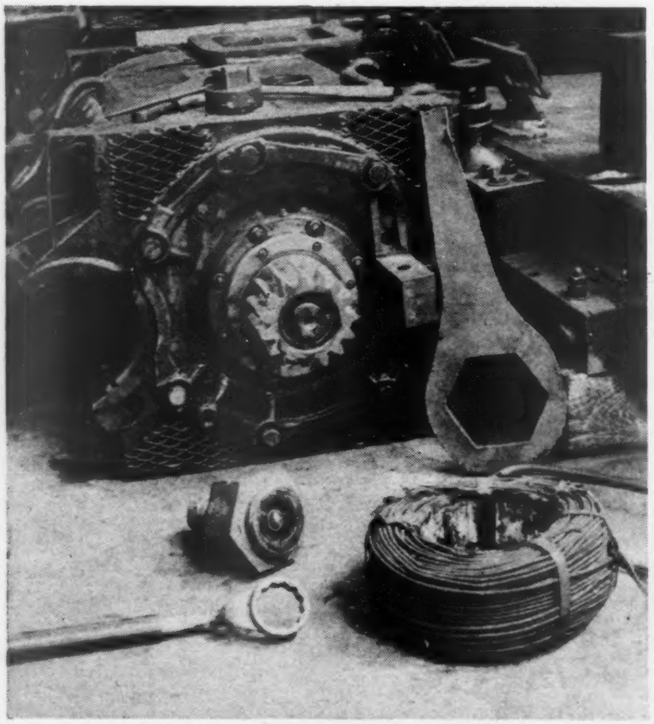


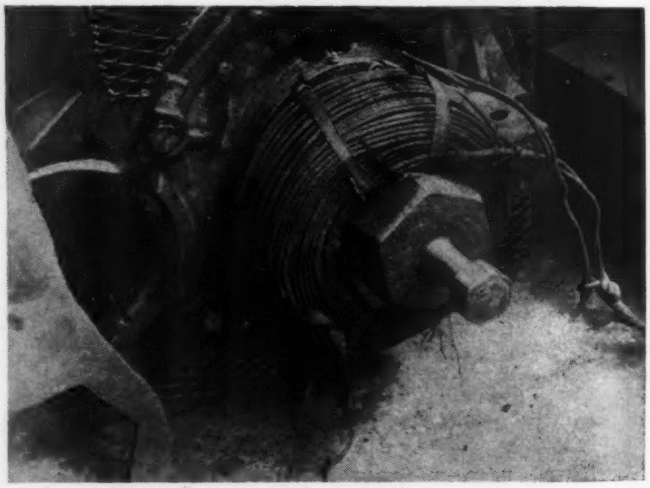
Fig. 1—Puller with coil and wrenches

HEATING Diesel locomotive motor pinions inductively for the purpose of applying them to the motor shaft is a widely adopted practice. It remained with the Erie shop at Marion, Ohio, to show they could be removed the same way.

The device shown in the illustrations is the first, somewhat crudely built, unit which was made for the purpose of pulling some odd-size pinions for which the hydraulic puller was not suited. The several parts of the puller are shown in Fig. 1. The hexagonal piece on the floor is a forging about 8 in. in diameter. One end is machined and threaded to fit the internal threads of the pinion. The center of the piece is also drilled and tapped to fit a crab stud such as used for the liner and head of a Diesel engine. This stud has the usual hexagonal head on one end, and the other end has a half cup fitted with a 1¼ in. steel ball.

To use the puller, the forging is first screwed into the pinion threads and tightened with the large wrench shown leaned against the motor. Since the puller is a small device which can be held in a man's hands, there is no problem of crossed threads when it is fitted into the pinion.

The smaller wrench shown in front of the forging is then used to tighten the stud so that the steel ball presses against the end of the motor shaft. This tends to



Above: Fig. 2—The coil in place on the motor pinion. Left: Fig. 3—After the stud is tightened and the switch closed, the pinion comes off, without heavy shock, in less than two minutes

pull the pinion off the shaft, but, of course, does not exert sufficient force to do so.

The heating coil is then applied as shown in Fig. 2. This coil was made from the only wire available when the first tests were made and consists of No. 12 weatherproof wire. It will be replaced with a neat coil made of No. 8 duplex magnet wire. The coil is then connected to a 440-volt single-phase source of 60-cycle a.c. power. The current flow is about 170 amp.

When the current is on, one man keeps the stud tight as shown in Fig. 3, while the other stands by with a hammer with which to tap the forging in case that is necessary to complete the removal of the pinion.

The current in the coil causes the pinion to act as the short-circuited secondary of a transformer, and due to the skin effect of a.c. current in steel, the heating is confined almost entirely to the pinion. This causes the pinion, and not the shaft to expand, and the pinion, aided by the pull from the stud, comes off in 1¾ to 2 minutes after the switch is closed.

The puller was designed and built by F. P. Lawler, electrical foreman, Erie Railroad.

CONSULTING DEPARTMENT

Can you answer the following question? Answers should be addressed: Electrical Editor, Railway Mechanical Engineer, 30 Church Street, New York 7.

We are expecting to install additional machines which may be driven from the existing line shaft. The present motor capacity will not be sufficient to carry the additional load. In order to save the expense of installing a new line shaft, we have thought of replacing the existing motor with a larger one on the same line shaft. What is recommended in this case?

We have a number of 200 watt lamps mounted on wall brackets and certain 60 watt lamps in pendant fixtures in our shop that seem to burn out oftener than lamps in other parts of the building. What may be the possible cause?

Capacitor Motors

We recently received a ½-hp., 120-volt, 60-cycle, single-phase motor of the capacitor type. The capacitor is burnt out and there is no name plate on the motor or capacitor. What is the purpose of the capacitor and what determines its size?

A Formula for Capacitor Size

While there are several types of single-phase capacitor motors, it is assumed that the question refers to the capacitor start, induction-run type of split-phase motor.

The main function of the capacitor is to make the current in the starting winding lead the line voltage by about 45 electrical degrees. The current in the main winding, due to its own inductance, usually lags behind the voltage by about 45 electrical degrees. The total phase displacement of the current in the main winding behind the current in the starting winding, therefore, becomes about 90 electrical degrees. The combined characteristics of the two windings become similar to those of a two-phase motor and produce a rotating magnetic field and torque.

The capacitor also reduces starting current and increases torque per ampere of starting current to about twice that obtained by the split-phase arrangement based on the inductive reactance starting principle. Too small a capacitor is just as undesirable as too large a capacitor. Lack of satisfactory torque and higher locked rotor current will result in both cases. With increasing values of capacitor, torque will increase to a maximum quite rapidly, then, as greater microfarad values are used, torque will decrease gradually but at a slower rate than it increased for the same capacity difference.

The proper value of capacitor for a capacitor-start, induction-run motor may be determined by the following formula:

Capacity in microfarads = 2650 × full-load current/terminal voltage.

The proper value of capacitor for a 25-cycle motor will be 60/25 of the foregoing 60-cycle value.

In selecting capacitors, the voltage rating of the capacitor insulation must also be considered in order to prevent eventual puncture and motor failure.

In the present case, the ½-hp., 120-volt, 60-cycle, split-phase motor draws about 6.4 amps. at full load. The suitable size of capacitor to start the motor satisfactorily may be calculated by substituting in the foregoing formula:

Capacity = 2650 x 6.4 amps./120 volt = 141 microfarads

R. G. Cazanjian

Rating Tables Are Available

The most usual type of capacitor motor is essentially a single-phase, split-phase motor having a capacitor connected in series with a starting winding. The result is a phase splitting action that causes the motor to start as a two-phase motor. A capacitor motor has considerably greater starting torque and lower starting current than the resistance split-phase motor. The usual type of capacitor motor, which is practically standard for fractional horsepower refrigeration machines, water pumps, etc., develops about four times normal full-load torque with around seven times normal full-load current. This type uses a centrifugal cutout that cuts out the capacitor and starting winding when the motor comes up to speed.

Another type of capacitor, not so usual, has an auto transformer for increasing the voltge applied to the capacitor, giving higher capacity effect and thus making possible the use of a smaller capacitor. Some capacitor motors start and run as two-phase motors. This type usually has two capacitors or an auto transformer in conjunction with a two-point starting switch.

If data are not available to determine the capacity of the capacitor required for a given motor, this may be determined accurately enough by consulting a table showing various sizes and types of capacitor for motors of different types and sizes. Any electrical dealer handling replacement capacitors will usually have such a chart. Capacitor ratings for the usual type of ½-hp. motor is from about 240 microfarad (mfd) to about 400 mfd. The larger capacitors are used for motors requiring higher starting torque. A capacitor having about 300 mfd. capacity will, in most instances, be close enough for most half-horse motors.

W. L. Cotton

NEW DEVICES

Rador Car Heating System

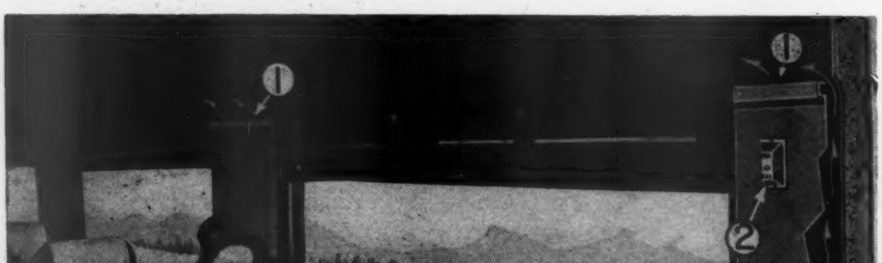
Rador, the war-developed heating modulation system, developed by the Vapor Car Heating Company, Chicago, is now getting its first peacetime use in a test installation on the Chesapeake & Ohio. The Rador control system is said to do for temperature what radar accomplishes in detection. A number of especially designed thermostats, each with its own search area, is constantly on guard for temperature deviations. This thermostatic search, upon encountering such deviation from the desired temperature, automatically alerts the heating equipment and corrects the condition in a zoned reaction. The result is maximum comfort at all times.

Key of the C. & O. installation is a special control panel, which automatically determines whether heating, ventilation, or cooling is to be used in establishing the desired temperature.

Each car is horizontally zoned to recognize such factors as train speed, wind velocity, car insulation, sun load and number of passengers in temperature control. Vertical zoning establishes the relationship between overhead and floor heat so as to insure proper balance for all heat sources.

Distribution of required heat is achieved primarily through panel radiation located at the sides of the car. The hot air rises through a duct from the side wall, with partial discharge occurring at the window sill. This supplies a thin heat veil over the cold window glasses to offset the chill air normally encountered at that point. The remainder of the hot air passes out through the continuous duct making up the entire side-wall panel of the car. The purpose of the panel is to offset radiation away from the body towards cold side walls and windows. Such radiant heating has already been successfully tested for the last few months on the Illinois Central.

Approximately 20 to 25 per cent of the side-wall heat is used by the radiant panel, the balance being discharged at the floor line to mix with car air by natural circulation. This prevents drafts, insures warmth at floor level, and provides vertical even temperature distribution. This radiated temperature is controlled by the Rador thermostats located throughout the car, which automatically adjusts the heating equipment through zone control and tend to prevent either over-heating or under-heating.



Schematic diagram of new Rador heating system, designed by the Vapor Car Heating Company and now being tested on C. & O. passenger car—(1) Warm air outlets; (2) thermostats to control unit fin; (3) heat deflector; (4) unit fin radiation; (5) thermostat to control radiation in floor; (6) radiation to warm floor

The core of the heating equipment is a finned tube over an inner steam feed pipe. Steam is permitted to enter this inner pipe from the control valve at one end and is then discharged at the far end into the finned tube for radiation. In this way, heat is delivered to the cold section of the car first. As the steam comes back to the control valve through this finned tube, it condenses, the condensate filling the space between the steam feed pipe and the finned tube and converting the entire unit into a heat-exchange medium.

In operation, steam is intermittently "jetted" through the control valve of the heating unit in a cycle determined by the Rador thermostats. Variations in the length of time for the "on" cycles are regulated to establish the correct heat-exchange value for meeting temperature requirements.

Anticipating all factors involving temperature comfort, Rador control is designed to adjust the output of the heating units immediately to varying requirements without any intermediate operations. Operated electrically, the control valve falls into the "open" position in the event of electrical failure, to permit manual adjustment where necessary.

Unique features incorporated in the Rador system provide for warm floors by means of heating coils placed below the floor, and vestibule heating which until now has never been done effectively. Because of its zoning provisions, Rador also permits temperature variations in parlors, lounges and lavatories when desired. It has been found, for example, that women prefer their lounges slightly warmer than do men, which is easily done with Rador.

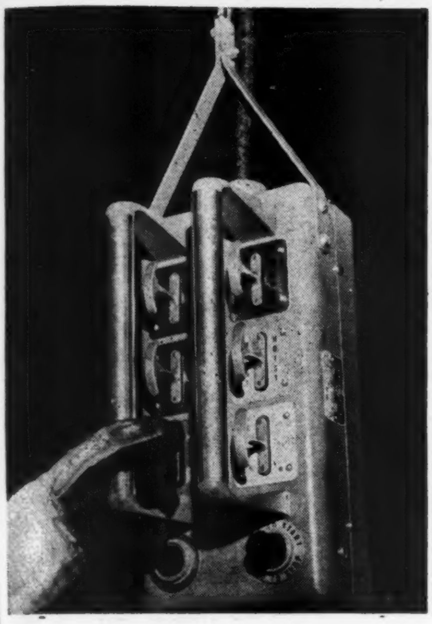
Because the system uses steam only in the amounts needed, a saving of over 20 per cent in the steam usually expended is anticipated. Economy diaphragms avoid steam blows under the cars and also prevent the accumulation of ice on running gear and equipment.

While the Rador system of heating modulation is applicable to various installations, initial efforts will be confined to meeting the needs of the railroads.

Floor Crane Control

A pendant pull-station control for floor-operated cranes, has been announced by the Control Division of the General Electric Company. Furnished for use on alternating or direct current with motors up to 15 hp. at 220 volts, the new control system can be used on cranes ranging in size from simple hoists to three-motion bridges, providing them with the same smooth operation and control refinements as cab-operated cranes.

The control system consists of a small magnetic control panel mounted on the



G. E. pendant pull-station control for floor-operated crane

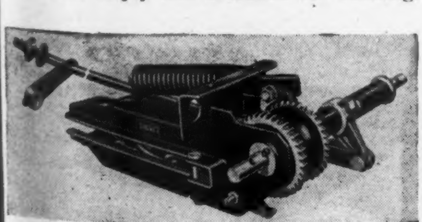
crane and connected by a cable to a pendant station which is suspended from the crane. It provides five-point, time-delay speed control for smooth, fast control of the crane movements. Because time-delay acceleration is provided in the pendant pull station, accelerating relays usually found on magnetic control panels are unnecessary, and therefore the size of the control panel is reduced.

The pendant station has one handle for each direction of crane motion. To operate a particular crane motor or crane motion, the corresponding handle is pulled. As the handle is pulled out, the crane motor accelerates to the speed indicated by the position of the handle in the operator's fingers. All crane motions can be controlled with one hand.

An emergency stop button instantly cuts off the power from all crane motors. Operation cannot be resumed until this stop button is manually restored to the "on" position and the momentary-contact, reset button is depressed.

Automatic Brake Slack Adjuster

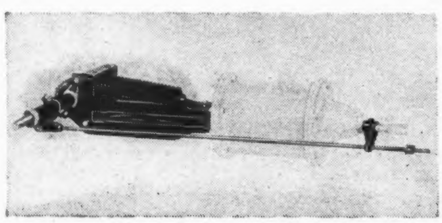
An automatic adjuster for brake slack has been designed by the Ajax-Consolidated Company, 3520 Carroll avenue, Chicago 24, to maintain brake-cylinder-piston travel at the predetermined amount throughout the life of the brake shoes and to compensate automatically for false piston travel between an empty and a loaded car running.



Ajax-Consolidated automatic brake slack adjuster

It also includes a safety indicator that forewarns carmen or trainmen of such defects as broken brake beams, brake hangers or brake rods, as well as any condition which might cause the brake-cylinder piston to strike the non-pressure head. The entire device is fully automatic in operation. There are no parts to clean or lubricate and it is said that after initial installation no further attention or servicing is required. Known as the Consolidated Automatic, this adjuster consists essentially of a main pressed-steel frame, ratchet drum and pawl, operating spring, and push-rod lever. It is adaptable to all kinds of freight-car equipment and may be attached to the brake-cylinder pressure head or to the underframe of the car.

In operation, when the brakes are applied and the brake cylinder piston moves out, the slack adjuster remains inoperative until the push rod arm on the push rod contacts the adjusting nut on the slack adjuster operating rod. When and if the piston travel exceeds the "standing empty travel", the slack adjuster operating rod, by its connection to the operating lever on the slack adjuster, revolves the hollow shaft on the slack adjuster counterclock-



An automatic slack adjuster applied to the pressure head of a brake cylinder

wise. The spring and pawl lever on the opposite end of the hollow shaft move back over the face of the ratchet wheel compressing the operating spring.

To prevent the slack adjuster from adjusting brakes when a car is loaded and running, thereby having too short a piston travel on the car empty, the pitch of the ratchet teeth in relation to the lever ratio, is such that it will require 1¼ in. excessive piston travel for the operation of the slack adjuster. This is the usual amount of false piston travel between an empty and loaded car running. In the event excessive piston travel on a loaded car running should be sufficient for the slack adjuster to operate, then approximately ⅜-in. piston travel will be taken up and the slack adjuster will not operate again until the brake-shoe, pin-hole, or pin wear allows another ⅜ in. excessive piston travel.

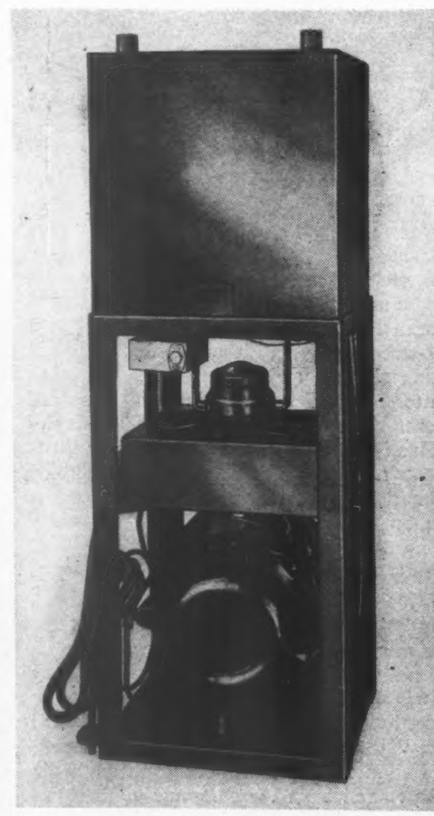
If a 7-in. piston travel on an empty standing car is desired, the false piston travel would go to approximately 8¼ in. on a loaded car running before the slack adjuster operates.

The operating lever is normally on a 45-deg. angle from the operating shaft. If, for any reason, such as broken beams, brake hangers or rods, the brake-cylinder piston should strike the non-pressure head, then the operating lever, enameled red, would be in a vertical position after the brakes had been applied. A trainman or a car inspector noting this could immediately see that some condition permitted the brake cylinder piston to travel its full limit, striking the non-pressure head of the brake cylinder, and would, therefore, look for defective brake rigging which might otherwise have gone unnoticed.

Electric Water Cooler

Designed to fit the requirements of railroad passenger cars, an electric drinking water cooler which operates on 115-volts a.c. power supply and occupies less than a square foot of floor area is announced by the Westinghouse Electric Corporation.

The new unit (Model WR4) may be mounted either on the floor or wall in a concealed location near the spigot and alcove. The refrigeration system is hermetically sealed at the factory, and only water



Westinghouse water cooler for railroad passenger cars

and electrical connections need be made at the time of installation. Parts which might require adjustment are easily accessible.

Copper tube water connections are provided at the top of the nickel-plated cooling chamber, which has a storage capacity of 9 pints. A 1/50-hp. motor drives the forced draft fan which cools the ⅙-hp. motor compressor and finned tube condenser at the bottom of the unit. The refrigerant is non-inflammable and non-toxic Freon-12. From an inlet temperature of 80 deg. F., 3.6 gallons of water per hour are cooled to 50 deg. F. under conditions of 90 deg. F. ambient temperature. Controls include an automatic, adjustable temperature control, and an automatic reset thermostat protecting the motor against overheating.

Milling Machines

Two knee-and-column type milling machines, designated as the No. 2 MI and the No. 2 ML, have been announced by the Cincinnati Milling Machine Company, Cincinnati 9, Ohio. The No. 2 MI is built in plain, universal and vertical styles, while the No. 2 ML is offered in plain and universal styles. Both machines have wide speed and feed ratios—60 to 1 and 120 tol, respectively—and cover the latest requirements for all types of milling operations.

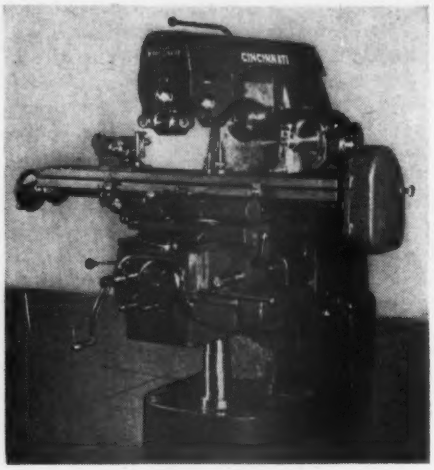
Sixteen spindle speeds, ranging from 25 to 1,500 r.p.m., are changed with a single crank-type control. The crank operates a hydraulic selector valve, while the actual work of shifting gears is performed hydraulically. One-half turn of the crank rotates the dial to the next numeral and meshes the proper gears for that speed Numerals on the dial are black-on-white, and 9/16 in. high for clear visibility. While the spindle is rotating a safety interlock prevents the speed-change crank from being moved. Feed rates are changed in the same manner as the speeds throughout the complete range of 16 feeds from 1/4 in. to 30 in. per min.

The spindle of the horizontal machines runs on three precision bearings—two tapered roller and one ball bearing. The rear bearing is not constrained endwise to allow for changes in the spindle length caused by heat and the pull of the draw-in bolt. Extra metal on the bull gear produces a fly-wheel effect, a desirable quality when using sintered carbide cutters, single tooth cutters, or end mills having widely spaced teeth. The main drive clutch is a single-disk dry-plate unit, with accessible adjustment. A multiple-disk spring-loaded brake, operated by the disengaging action of the starting lever, stops the spindle instantly when the drive clutch is disengaged.

Lubrication of these machines is principally automatic. Parts within the column and knee are automatically lubricated from individual pump and cascade systems with tubes carrying oil into out-of-the-way bearings. The vertical feed screw has its own lubricating system with the vertical screw running in a bath of oil displacing and admitting its own volume through the tube to and from the reservoir as the knee is traversed up and down. Table ways and parts within the saddle and housing are lubricated by a manual pressure system built into the saddle.

Feed controls are independent of each other, and each feed lever has a forward, neutral, and reverse position. All are equipped with plastic knobs for convenience of the operator. Knee and saddle clamping levers, the starting lever, and the overarm pilot wheel have similar plastic knobs. Cross and vertical hand cranks are automatically disengaged when the respective power feed lever is engaged. The arrangement constitutes an important safety feature for the operator, as it prevents the hand control from spinning during the feed or rapid-traverse movement.

The micrometer dials for the manual-adjustment controls are large with deeply cut graduations for clear visibility. To reset the dials, they are merely pulled out against a light spring pressure, and rotated



The Cincinnati No. 2 MI universal milling machine

to the desired setting. Rapid traverse, at the rate of 150 in. per min. longitudinal and cross, and 75 in. per min. vertical, may be engaged through a lever control at the side of the knee. The starting lever may be adjusted to any position desired by the operator through a conventional straight-tooth clutch.

The overarms are rectangular castings, fitted in dovetail ways at the top of the column. A built-in vibration damper reduces the need for the arbor-support brace except for the most unfavorable cutting conditions. The arbor-support brace supplied with these machines consists of a single vertical section which is bolted to the arbor support, while the lower end is a bridle section which clamps to the top of the knee. The brace may be reversed, as desired by the operator, presenting the vertical section to the right or left of the knee.

Electrical controls are built in for protection against dust, coolant, and damage. The controls for potentials higher than 220 volts include a transformer which protects the operator by a reduction to 110 volts at the push-button station. If the operator forgets to shut off the current before opening the motor compartment door, a button automatically breaks the circuit and immediately stops the motor.

The coolant system features complete enclosure of the centrifugal pump, the drive shaft, and the greater portion of the coolant supply piping, all of which is recessed into the front right-hand corner of the machine column. The pump and its drive shaft may be exposed for servicing by removing a long, narrow cover which blends into the wall of the column.

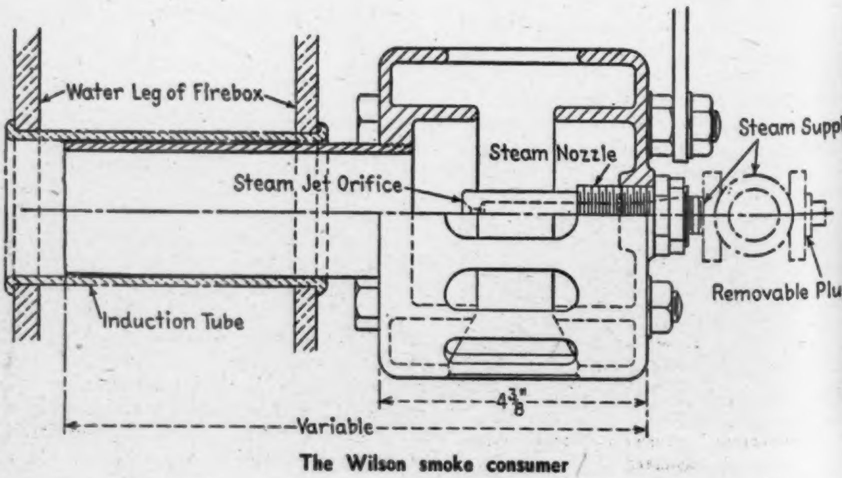
All rotating shafts are completely covered to protect the operator. The cross screw is also covered and protected against the wearing effects of dust and chips by sliding covers on the right-hand side of the knee.

Vertical-style machines have essentially the same controls and construction as horizontal machines. The vertical head has its own lubrication system, consisting of two plunger pumps operated by the action of an eccentric collar on the vertical spline shaft. Vertical machines are equipped with power feed and power rapid traverse to the head, and a four-position turret stop. Feed rates to the head range from 1/8 in. to 15 in. per min., while the rapid traverse rate is 75 in. per min. The turret stop serves as a quick and convenient adjustment of the head when milling production work having finished surfaces at various heights. At the left-hand side of the vertical head, a lever operates a taper-gib clamp which extends the full length of the head ways and clamps the head.

Smoke Consumer

To meet the increasingly exacting requirements for the reduction of steam-locomotive smoke, and at the same time keep objectionable noise to a minimum, a smoke consumer has been developed by the Wilson Engineering Company, 122 South Michigan avenue, Chicago 3. Smoke is reduced by the aspiration of air through the firebox combustion tubes. Noise is muffled by acoustic filters operating on the principle of the conventional automobile muffler.

The device is mounted with the air-supply tube extending through the induction tube between the sheets comprising the water leg of the firebox. The air tube is available for fitting induction tubes with diameters of 2, 2 1/2, or 3 in. The jet orifice may be 3/32, 1/8, or 5/32 in., respectively, in diameter. A removable plug fits the steam-supply cross or tee to facilitate cleaning with 1/16-in. hard wire.



The Wilson smoke consumer

To introduce the necessary amount of air into the interior of the firebox, steam is fed to the orifice from the outside through a ½- or ¾-in. cross or tee. The action of the steam flowing through the jet entraps the air and imparts to it a velocity head to force it into the firebox, where it contributes to more nearly complete combustion. To suit varying conditions the steam nozzle is adjustable longitudinally up to ½ in. A locomotive set comprises from four to six of these individual devices.

Spencer Spring Suspension

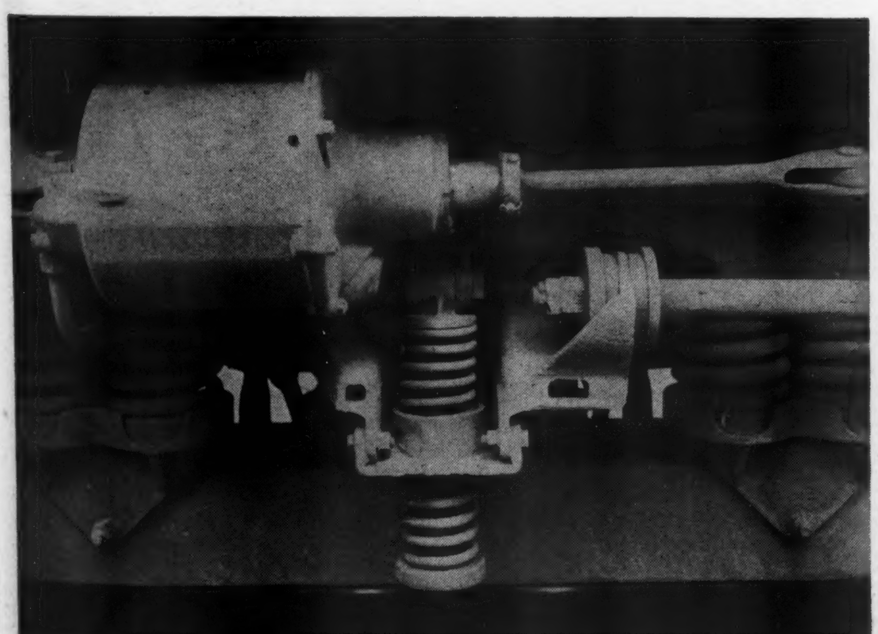
A new type of spring arrangement, known as the Spencer spring suspension, designed to retard car-body roll and promote smoother riding of railway passenger cars, has been developed by the Railway Products Company, Chicago. The device consists simply of a double-acting spring, with the necessary resilience characteristics, connected between the truck frame and bolster end on each side of the truck and acting to cushion car-body roll by resisting bolster movement both up and down with respect to the truck frame. The location of the Spencer springs at the bolster ends assures a maximum effective torque arm, and, moreover, the springs on both sides of the truck exercise a steadying influence each time there is any tendency for the car body to roll.

Referring to the illustration, the construction of the Spencer spring suspension and its method of attachment to a 4-wheel truck will be apparent. The device consists of an upper anchor bracket, bolted to the truck frame and pin connected to an upper spring-seat bracket; a central spring-seat bracket bolted to the bolster, and a combination bottom spring seat and nut, with two coil springs inserted between the respective spring seats. The entire assembly is held together at desired spring tension by means of a 1-in. alloy steel through-bolt, threaded into the truck-frame bracket at the upper end and into the combination spring-seat nut at the lower end.

The coil springs, made of ⅝-in. round alloy steel, are 4¾ in. in outside diameter and each has an assembled height of 6 in. and maximum travel of 3½ in., or the same as that of the bolster coil springs. The free height is 10 in. for the top Spencer spring and 11 in. for the bottom spring.

Advantages claimed for the Spencer spring suspension include notable simplicity; elimination of any working fluid, valves, or wearing parts; operation unaffected by climatic changes; no adjustments required for varying service conditions; all parts visible for inspection purposes and easily replaceable when necessary.

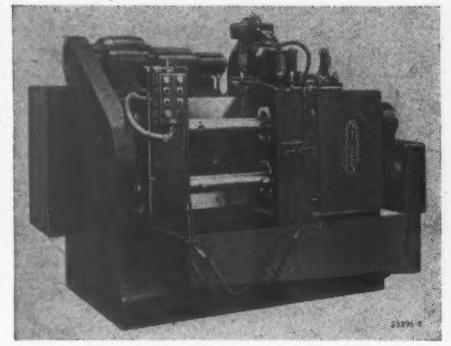
Spencer spring suspensions have been operated successfully in test service on several dining, lounge, coach and other streamline passenger cars since 1944 and it is said that a total of about 1¾ million miles of service have been accumulated without requiring any replacement of parts, or other maintenance attention. Coil springs of the same capacity were used under all of the different classes of cars mentioned, thus indicating that only one type of Spencer spring suspension is required for present four-wheel trucks under streamline equipment.



Spencer spring suspension applied to a four-wheel passenger-car truck

Journal Bearing Borer

A hydraulic journal bearing borer capable of boring four journal bearings of the same size and chamfering both ends in one cycle is available from the General Machinery Corporation, Niles Tool Works Division, Hamilton, Ohio. The machine can handle journal bearings ranging from 4¼ in. by 8 in. to 7 in. by 14 in. through the use of spacer inserts and clamping plates in the work-holding fixtures. It is arranged for automatic hydraulic feed and traverse control to the work saddle, permitting also manual control of all operations. The only functions required of the operator are loading, unloading and starting the machine by push button.



The Niles hydraulic journal bearing borer has a capacity of four bearings per cycle

There is an infinite fine chamfering and boring feed selection within the range of the machine in both directions. The most efficient feed for a particular speed may thus be selected. Fast traverse in both directions is obtainable for maximum production. One spindle speed is provided, 160 r. p. m. for standard cutting tools or 350 r. p. m. for carbide cutting tools. Other speeds may be had by changing pulleys. The boring feed ranges from 0 to 35 in. per min.

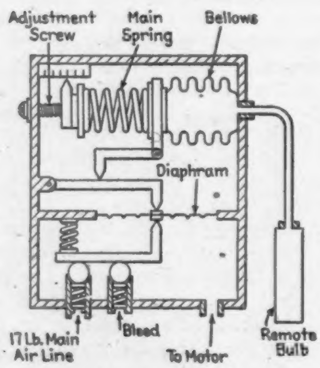
The drive to the two fixed-positioned revolving boring-bar spindles is located on the left side of the machine. This drive is through Texropes and fully enclosed heat-treated gears to the boring-bar spindles. All gears and the spindles are mounted in automatically lubricated anti-friction bearings. The boring bars are heat treated. They have three cutters, one for boring and one each for chamfering the right and the left side. A 10-hp. constant speed motor drives the cutter spindles and a 3-hp. constant speed motor drives the hydraulic pump. Either a. c. or d. c. motors may be had.

Diesel Engine Temperature Control

To compensate for the greatly fluctuating loads which occur in locomotive Diesel engines and which require temperature control above and beyond the mere manual control for changes in outside conditions, a system for temperature regulation has been developed by the Minneapolis-Honeywell Regulator Company, Railway Controls Division, 221 Fourth avenue at 18th street, New York 3. It is a pneumatic modulating control system, automatic in operation, that is said to be capable of maintaining engine cooling-water temperature within 2 deg. F. of the control point, and to eliminate both excessively high temperatures which cause carbonization in the cylinder walls and excessively low temperatures which reduce operating efficiencies. Changes in bearing clearances and the ignition point, and mental fatigue due to expansion and contraction resulting from temperature changes are minimized.

The principle of modulation employed in

this system can best be understood by comparing the temperature control point of the engine water to a level of liquid in a tank having a hole in the bottom. If this level is to be maintained by means of a bucket, the level of the liquid necessarily would vary above and below the point at which it is to be maintained. If, on the other hand, a spigot were located above the tank and its flow automatically controlled so as continuously to replenish the outgoing water at its discharge rate, the



Operational diagram of the thermostat

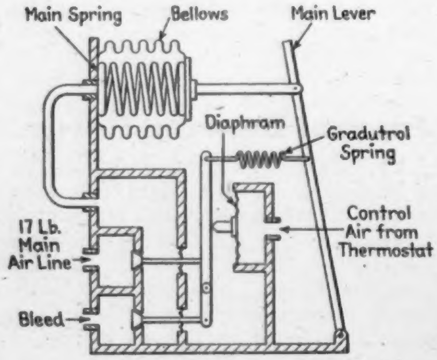
liquid could be maintained at a constant level. This is the principle of temperature modulation as contrasted with manual or "on-off" control changes, which are comparable to the use of the bucket in replenishing the liquid in the tank. In other words, with modulating temperature control the cooling water is not permitted to undergo the wide fluctuations in temperature that occur in a system of "on-off" control.

This air-operated system is applicable to all types of Diesel-electric locomotives and special provisions may be made for such additional auxiliary controls as high- and low-temperature alarms, engine-temperature regulator lights and remote control switches. Where the engines are operated in very cold climates by-pass valves may be installed, and these by-pass valves can be operated in simple sequence with the pneumatic controls at the same temperature-control point throughout the year without any change in the mechanical linkage. The speed of the cooling fan can also be regulated without any fundamental change in the pneumatic circuit. Under conditions in which two engines operate with one shutter in common, a selector relay may be installed to permit the warmer engine to take over the control of the common shutter.

Air is furnished at the 15 to 17 lb. per sq. in. required for operation of the system by an air-reduction station. A pneumatic thermostat measures the engine-water cooling temperature and directs the air-operated motor which positions the shutters or by-pass valves, or varies the speed of fans individually or in combination, as the case may be, to control the flow of air over the radiators. These pneumatic motors are linked one to a quadrant to position the shutters and move both the quadrant and the handle as a unit. If the air supply fails on the engine the control causes the air pistons to place the quadrant operating the shutters in normal position so that the handles can be used to operate the shutters manually.

The sensing element of the thermostat is located in the cooling-water system and measures the temperature of the water. Any change in temperature is relayed to the valve system in the thermostat which makes a proportionate change in the air pressure in the control line to the motor. This pressure change causes the motor to move to a position of balance to position the shutters, and to manipulate a by-pass valve or a fan-speed device if used. In this way the system modulates the flow of air or water through the radiators to maintain a stable temperature.

The thermostat is operated through vapor pressure in the remote sensing bulb, which changes as the temperature of the bulb changes. These pressure variations are transmitted to the bellows which operates the levers controlling the main air valves. On a temperature rise, the bellows overpowers the main spring and operates the levers to open the main air-line valve. Air enters the valve and increases the control air pressure until it forces the diaphragm back to a point where it balances the bellows' pressure. On a temperature drop,



How control air from the thermostat operates the motor

the bleed valve is opened and air is allowed to escape until the control air pressure is in balance.

The motor is operated by control air pressure from the thermostat transmitted to the diaphragm which operates the valve mechanism. A rise in control air pressure moves the top of the lever connected to the two air valves to the left, opening the main air-line valve. Air enters through this valve and increases the pressure in the bellows causing it to overpower the main spring and to operate the main lever. The main lever is moved until it applies enough tension on the gradutrol spring to force the diaphragm back and allow the valve to close. On a pressure drop, the bleed valve is opened and air is released until the pressure drops sufficiently to allow the lever to return to a point where the gradutrol spring will again balance the control air pressure on the diaphragm.

A pilot relay in the motor supplies full power for small as well as large control movements. Thus full air pressure is available at all times to move the shutters, and not only when the thermostat is completely off the control point and struggling to maintain the temperature.

Train Radio Pack-Set

A portable two-way FM, VHF radio pack-set has been designed by the Radio Division of the Bendix Aviation Corporation, Baltimore, Md., to extend end-to-end railroad voice communications to the track-side. The set which bears the designation MRT-2B has a self-contained rechargeable power supply and is a compact unit which is to be carried by a shoulder strap so that the metal case hangs on either hip. The 36-in. antenna which retracts into the case is designed so that the equipment is turned "on" when the antenna is completely extended. When not in use, the antenna retracts into the case and the radio set is automatically turned "off." The antenna when fully extended is a half-wave type at the railroad radio frequencies, namely 158.25 mc. to 161.97 mc.

The all-over size of the case is 11⁹⁄₁₆ in. high by 8⅛ in. wide by 4³⁄₁₆ in. deep. The weight including power supply and handset is 15 lb. 2 oz. Both the transmitter and receiver are crystal controlled and are especially designed for use with the Bendix two-way train radio units. Both sets are built on a single small chassis using nine miniature type tubes.

The receiver utilizes a super-heterodyne circuit to obtain maximum sensitivity and gain. The transmitter is activated by a push-to-talk button on the earphone, and the circuit is so designed that filaments of the receiver are not in use when the transmitter is in operation and vice versa. This saves current and provides for economical use of the portable power supply.

The power supply may be easily and

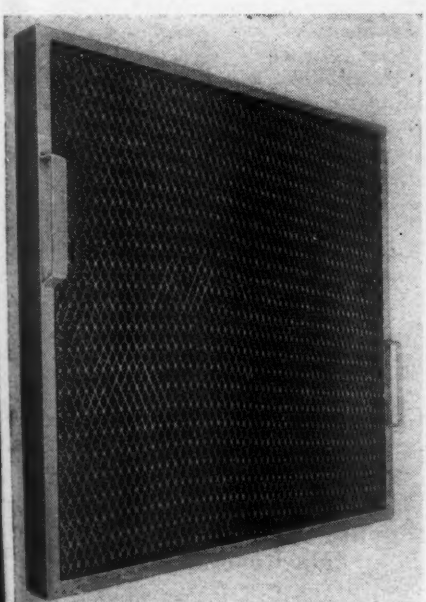
The pack-set in use

quickly removed for recharging. It consists of a completely enclosed band of miniature non-spillable storage batteries which activate a tiny dynamotor, designed for a 6-volt input and a 100-volt output. The filaments operate from a 1½-volt source. The battery is enclosed in a metal box which is ventilated with an external escape vent so that no fumes accumulate within the enclosed case.

Each pack-set may be equipped with two power-supply units so that when the pack-set is returned to the caboose, the battery may be removed from the carrying case and recharged, while the second set of batteries provide for continued operation. This arrangement assures from two to three hours constant usage with several hours intermittent usage. Recharging may be done from either a.c. or d.c. sources. Approximately one mile solid communication is normally obtained in pack-set to mobile or fixed station operation. The unit may be used in any weather.

High-Velocity Air Filter

An all-metal cleanable air filter, designed to perform efficiently at an approach velocity of 432 ft. per min. and pass 1,200 cu. ft. per min. through a 20-in. by 20-in. filter



The Agitair FM filter made of layers of expanded metal

panel, is being offered by Air Devices, Inc., 17 East Forty-second street, New York 17.

The media consists of layers of expanded metal so disposed as to induce turbulent cyclonic action of the air within the filter, thereby creating a centrifugal wiping action against all viscous surfaces of the media. It is claimed that the filter operates at high velocities with sustained low resistance to air flow, and has both great dust holding capacity and high dust holding efficiency.

The all metal parts are ruggedly constructed to withstand the mechanical abuse of cleaning, with frames made of cold-rolled steel and arc welded to assure long life. Easily removed for cleaning and servicing, the filter can be quickly reinstalled to peak efficiency.

Inside Tubular Micrometers

The measurement of bores without removing boring bars is now possible with the tubular over-the-bar inside micrometers manufactured by the Tubular Micrometer Co., St. James, Minn. This precision measuring device is used to determine bore sizes over or around center obstructions. It is not necessary to remove the

It is unnecessary to remove the boring bar to take measurements with the tubular inside over-the-bar micrometers

boring bar nor to disturb the cutter settings. The reading is taken with the micrometer placed around the bar in the correct measuring position.

These inside micrometers are made with hollow-box type steel frames, and embody the rigidity of tubular construction plus a saving in weight. Because of this structural lightness, the micrometers are easy to handle. Feather-touch feel is obtained since operator effort is reduced to a minimum even with the large units.

All frames have a vacuum in the center to insure minimum expansion and contraction, and to dissipate hand heat. The frames are hydrogen brazed and plated with copper, nickel and heavy chrome to resist wear and perspiration. The spindle is made of hardened and ground tool steel. Micrometer threads are ground from the solid and lapped to a true fit with the barrel. Graduations on the barrel and thimble are sufficiently large to insure easy reading. Should the micrometer become worn through excessive service, there are three points where it may be adjusted for wear: the spindle bushing, the mandrel and the thread, as well as at the reading.

The standard range of sizes of this instrument is from 8 in. to 28 in., and will cover bar diameters from 4 in. to 8 in. Each micrometer will fit over a variety of bar sizes. Thus, the 13½-in. to 18-in. set shown will cover any bar up to 7½ in. in diameter. Mandrels in ½-in. steps will fit any bore diameters within the established range. Special tubular micrometers for larger size bores may also be obtained upon application.

Sodium Lamps With Greater Life

Sodium lamp life ratings of 4,000 hours for intermittent burning and 8,000 hours for constant burning have been announced by the Lighting Division of the General Electric Company. This represents double the life ratings specified when the sodium lamp was first introduced.

Sodium lamps, which emit an amber (caution) light, can now be expected to give approximately nine months' to one year's service. This is an increase of one-third over the previous 3,000-hour burning rate, and results in a saving in the cost and servicing of sodium installations. The price of the lamp has not been increased.

The sodium lamp is now serving effectively for the lighting of highway-railroad grade crossings.

Neon-Glow Voltmeter

A midget Neon-glow meter called the Mini-Volt, that indicates a.c. or d.c. voltages over a wide range, has been announced by Industrial Devices, Inc., Edgewater, N. J. It is a simple meter of practical accuracy which has only one hand-operated moving part and is, therefore, a

When the knob indicator is turned up to a reading corresponding to the applied voltage, the glow is extinguished

rugged meter. Since it employs a Neon-glow tube and high resistance, it is virtually burnout-proof. It is housed in a Bakelite case and provided with 12-in. flexible test leads with prods. Calibrated for use on a.c. from 65 to 660 volts, with an impedance of approximately ½ megohm, it is operated merely by turning the knob until the neon glow extinguishes, whereupon the voltage is read directly off the scale. For d.c., which is indicated when only one electrode of the neon indicator glows, the reading is multiplied by 1.15. Because of its high impedance value, it may be used to measure plate voltages in radio work and for checking leakage.

NEWS

William T. Faricy Becomes A. A. R. President

WILLIAM T. FARICY, vice-president and general counsel of the Chicago & North Western, was elected president of the Association of American Railroads at a March 28 meeting of the board of directors in Washington, D. C. He assumed office on April 1 as successor to R. V. Fletcher, who had served since the death on November 12, 1946, of John J. Pelley, with the understanding that he was to be relieved as soon as a successor could be chosen. Judge Fletcher, former A. A. R. vice-president and general counsel and more recently vice-president—research, will not return to the latter position, but will continue as special counsel for the association in the so-called Georgia and Lincoln anti-trust cases, and will bring to a conclusion by July 1 the work of the Railroad Committee for the Study of Transportation, of which he is chairman.

Orders and Inquiries for New Equipment Placed Since the Closing of the April Issue

LOCOMOTIVE ORDERS

Road	No. of locos.	Type of loco.	Builder
Canadian Pacific	13	1,000 hp. Diesel-elec. switch	American Loco. Co.
Chicago, Indianapolis & Louisville	7	1,500-hp. Diesel-elec. road type switch.	American Loco. Co.
	6	1,500-hp. Diesel-elec. road type switch.	Electro-Motive
	2	1,500-hp. Diesel-elec. road type switch.	Fairbanks, Morse
Chicago, Milwaukee, St. Paul & Pacific	4	2,000-hp. Diesel-elec., A units	Fairbanks, Morse
Kansas City Southern	4	2,000-hp. Diesel-elec., A units	Fairbanks, Morse
Southern	3	6,000-hp. Diesel-elec. frt.	Electro-Motive
	4	1,500-hp. Diesel-elec. switch	Electro-Motive

FREIGHT-CAR ORDERS

Road	No. of Cars	Type of car	Builder
Atchison, Topeka & Santa Fe	500	50-ton auto box	Pressed Steel Car
Belt Railway of Chicago	50	70-ton hopper	General-American
	20[1]	30-ton cabooses	Internat'l
Canadian National	500	50-ton automobile	Canadian Car & Fdry.
	1,500	50-ton box	Canadian Car & Fdry.
	250	50-ton ore	National Steel Car
	150	70-ton covered hoppers	National Steel Car
	500	50-ton box	National Steel Car
	1,700	50-ton box	Eastern Car
Canadian Pacific	1,750	50-ton box	Canadian Car & Fdry.
	750	50-ton box	National Steel Car
	120	50-ton automobile	National Steel Car
	100	70-ton covered hopper	National Steel Car
	325	50-ton refrigerator	National Steel Car
	50	Caboose	Company Shops
	250	70-ton hopper	Eastern Car
Chicago & North Western	1,400[2]	50-ton box	American Car & Fdry.
Cudahy Packing Co.	150	40-ton refrigerator	Company Shops
Denver & Rio Grande Western	500	50-ton gondola	Pressed Steel Car
Fruit Growers Express Co.	1,100[3]	40-ton refrigerator	Company Shops
Detroit & Mackinac	25	50-ton hopper	
	10	70-ton covered hopper	General American
Kansas City Southern	400	50-ton box	Pullman-Standard
New York, New Haven & Hartford	1,000	50-ton box	Pullman-Standard
Northern Pacific	1,000	50-ton box	Company Shops
Southern	3,000	50-ton box	Pullman-Standard
	1,000	50-ton hopper	American Car & Fdry.
	150	70-ton covered hopper	Pullman-Standard
Southern Pacific	500[4]	70-ton flat	American Car & Fdry.
	100[4]	70-ton gondola	Company Shops
Wabash	300	50-ton box	Company Shops

FREIGHT-CAR INQUIRIES

Road	No. of Cars	Type of car	Builder
Chesapeake & Ohio	3,000	Hopper	
Missouri-Kansas-Texas	500	70-ton hopper	
New Jersey, Indiana & Illinois	100	50-ton automobile	
New York Central	2,000	50-ton box	
Union Pacific	400	70-ton covered hoppers	

[1] Delivery received.
[2] 400 for the Chicago, St. Paul, Minneapolis & Omaha.
[3] Contemplated.
[4] The item in the April issue reporting that the Southern Pacific had ordered 100 gondolas from the General American Transportation Corporation was in error in that the order placed with that company was for 100 70-ton covered hoppers.

NOTES:—*Clinchfield.*—The Clinchfield has purchased 6 steam locomotives of the 4-6-6-4 type. Built for the United States government by the American Locomotive Company in 1943, the engines had been leased to the Denver & Rio Grande Western.

New York, New Haven & Hartford.—The New Haven has received permission from the United States district court at New Haven, Conn., to spend $9,900,000 for new equipment. Permission was granted the New Haven to purchase 10 steel multiple-unit motor passenger cars and 36 trailer passenger cars at a total cost of $3,600,000 and 1,000 steel box cars costing $3,900,000 and to rehabilitate 40 multiple-unit cars and 64 trailer cars at a cost of $2,400,000.

Union Pacific.—Three hundred Union Pacific stock cars will be reconditioned and equipped with Timken roller bearings and steel wheels in the road's own shops at a cost of more than $300,000.

Chicago & North Western.—According to R. L. Williams, president of the C. & N. W., the road's "1947 budget calls for acquisition of a substantial amount of new passenger and freight equipment. Equipment which has been authorized for purchase, but not yet placed on order, consists of 21 Diesel switching locomotives and 1,400 box cars. In addition, we now have on order 78 streamline passenger cars of which 16 are sleepers; 19 2,000-hp. and one 1,000-hp. Diesel-electric passenger locomotives; eight 4,500-hp. Diesel-electric freight locomotives; seven 1,500-hp. Diesel-electric freight locomotive units and 140 70-ton covered hopper cars. All this new equipment will cost approximately $25,500,000." Mr. Williams explained that, in addition, 500 steel hopper cars will be rebuilt by the line at its Winona (Minn.), shops, which work is already in progress.

R. S. M. A. Prepares for June Conventions

THE Railway Supply Manufacturers Association, which will have charge of the great exhibition in the Convention Hall at Atlantic City during the Mechanical Division and Purchases and Stores Division, A. A. R., meeting, June 23-28, is making splendid headway in its preparations. The officers are: President, Norman C. Naylor, American Locomotive Company, New York; vice-president, C. W. Floyd Coffin, Franklin Railway Supply Company, New York, and secretary-treasurer, A. W. Brown, Room 1424, 30 Church St., New York 7.

The chairmen of the various committees are: Exhibit Committee, C. W. Floyd Coffin; Finance Committee, Charles J. Nieman, Pittsburgh, Pa.; Badge Committee, Raymond P. Townsend, Johns-Manville Sales Corporation, New York; Hotel Committee, Carter P. Whitcomb, Griffin Wheel Company, Chicago; By-Laws Committee, E. J. Fuller, Hunt-Spiller Manufacturing Company, South Boston, Mass.; Canadian Committee, Webb G. Krauser, Canadian Cardwell Corporation, Montreal, Que.; Foreign Relations Committee, Charles W. Wright, Pullman-Standard Car Export Corporation, Washington, D. C.; Entertainment Committee, Joseph E. Brown, Magnus Metal Corporation, New York; Enrollment Committee, M. K. Tate, Lima Locomotive Works, Washington, D. C.; and Transportation Committee, C. C. Bailey, General Electric Company, Schenectady, N. Y.

Weil Becomes A.R.S.A. Secretary

C. F. WEIL, sales representative of the American Brake Shoe Company, at Chicago, has been elected secretary of the Allied Railway Supply Association, succeeding Joseph F. Gettrust, deceased.

Foundrymen Award Medals for "Meritorious Service"

THE American Foundrymen's Association, technical society of the castings industry, during its annual convention at Detroit, Mich., April 28 to May 1, awarded four "meritorious service" gold medals and two honorary memberships. Among the medal recipients were: Russell J. Allen, metallurgical engineer of the Worthington Pump & Machinery Corp., Harrison, N. J., cited "for his earnest and unceasing contributions toward the advancement of gray iron technology;" Dr. Richard A. Flinn, metallurgist, Mahwah (N. J.) research group of the American Brake Shoe Company named for the Peter L. Simpson medal, in recognition of "outstanding" work during the past year "in the field of chilled and white irons;" and Harry M. St. John, brass foundry and forge shop superintendent of the Crane Company, Chicago, awarded the Willian H. McFadden medal

for "outstanding work in the field of non-ferrous castings research over a period of many years."

Defective Coupler and Brakes Cause of Car Runaway

A DEFECTIVE coupler, defective air-brake equipment, and a defective hand brake caused the February 28 accident wherein the thirteenth and last car of the Pennsylvania's westbound "Sunshine Special" became separated from the standing train at the top of a grade in the Allegheny mountains near Gallitzin, Pa., according to the report of an Interstate Commerce Commission investigation conducted under the supervision of Commissioner Patterson. The runaway car, a lightweight, all-room sleeper, rolled down the grade eastward 3.37 miles, where it was derailed on a 9 deg. 15 min. curve, the derailment causing the car to overturn and slide on its side until it struck a rock wall and stopped "practically upright."

The accident resulted in the death of a Pullman porter, and the injury of 12 passengers and one train-service employee. The commission's report charged two violations of the Safety Appliance law.

"Under the Safety Appliance Law," it said, "all passenger-train cars are required to be equipped with efficient hand brakes. The movement of the thirteenth car without an efficient hand brake was in violation of the Safety Appliance law. In addition, the Safety Appliance law requires all cars used in moving interstate traffic to be equipped with couplers which can be uncoupled without the necessity of men going between the ends of the cars. The coupler at the rear of the twelfth car could not be uncoupled by the use of the uncoupling lever, and the condition of this coupler was in violation of the Safety Appliance law."

The "Sunshine Special," identified in the report as No. 3, consisted of a steam locomotive and 13 cars, the ninth and thirteenth (the runaway) being of "lightweight, high-tensile-steel" construction and the others of "conventional all-steel construction." At Altoona, where a second engine was put on the head end to assist the train to Gallitzin, a terminal air-brake test was made.

The train left Altoona at 3:13 a.m., and because of inadequate steam pressure it stalled about one mile east of Gallitzin. After a delay of about 16 min. it proceeded to Gallitzin, where it stopped at 3:54 a.m. Soon afterward the head engine was detached and a road air-brake test was made. Then, when an attempt was made to start the train, the rear car, the Pullman "Cascade Mirage," became detached. As noted above, the car moved eastward out of control to its derailment 3.37 miles east of Gallitzin. This was about 4:08 a. m. when the weather was "clear." The report estimated that the car's overturning speed on the curve involved would be about 62 m. p. h.

The car's light weight is 127,500 lb. and is 84 ft. 6 in. long between coupler pulling faces. It is fitted with two four-wheel trucks spaced 59.5 ft. between the truck centers, and has clasp brakes on all wheels. The journals are equipped with roller bearings.

The hand-brake equipment is of the horizontal-lever ratchet type provided with a hand-clasp latch, mounted on a staff through the buffer beam at the B end of the car (the rear end of the car in the train) and near the left diaphragm post. Among other parts of the brake, which the report described in detail, is a cast-steel pawl, slightly angular in shape, one end of which has a long and short tailpiece for the insertion of a person's foot and the other end a tooth to engage the notches of the ratchet wheel. The pawl is provided with a 1-in. cast-steel trunnion to which it is secured by a ¾-in. bolt and washer.

The hand-brake equipment applies braking force on the two wheels at the left side of the B-end truck. The commission's investigation disclosed that the flagman attempted to stop the car by the use of the hand brake, but "could not force the pawl into position to engage the ratchet." Examination of the brake after the accident disclosed that the long tailpiece of the pawl was broken adjacent to the trunnion.

"Discoloration of the metal of the pawl," the report continued, "indicated that the break had existed during a considerable period of time. It appeared to have been broken as a result of its having been struck a severe blow by some metallic object. In addition, the trunnion was corroded to such an extent that the pawl could not be moved by striking it with a hammer. The hand-brake system was arranged to provide a braking ratio of 39 per cent of the light weight of the car. If the hand brake had been in operative condition, this accident would not have occurred."

Pennsylvania brake instructions quoted in the report provide that where inspectors are employed to make a general inspection of cars upon arrival at a terminal, they "must make a visual inspection of . . . hand brakes . . . and make necessary repairs." The instructions say further that "all parts and connections of the hand brakes should be carefully examined and any necessary changes and repairs made." Also, there is a rule stipulating that "a car having the hand brakes inoperative must never be the rear car of a train." The equipment of No. 3 was last inspected by members of the mechanical force at Altoona about 50 min. prior to the time the accident occurred, but "no defective condition was observed."

The air-brake equipment of the car consists of a D-22-AR control valve, a combined auxiliary, emergency, and displacement reservoir, two 16-in. by 72-in. supply reservoirs, a 12-in. by 10-in. brake cylinder mounted on each side of each truck, two conductor's emergency valves, and an F-6 relay valve, related piping and armored-type air hose at each end of the car. "The four brake cylinders of this type of brake system are connected to common supply reservoirs," the report continued. "After a brake application excessive leakage from one cylinder will deplete the supply reservoirs and pressure in all four brake cylinders within a short period. Repeated application and release of the train-brake system within a short period will deplete all reservoir pressures."

Tests of the car's air-brake system disclosed that the packing cup of the left rear brake-cylinder piston was ruptured. This condition, the report said, permitted brake-cylinder pressure to escape through the breather port and "as a result, the brake would release in about 3½ min. after a 20-lb. brake-pipe reduction was made." The brake would release from an emergency application "after an interval of 2 min. 20 sec."

"The brake-cylinder piston-packing cup was of the Buna-S rubber, 12-in., snap-on type," the report went on. "The packing cup had become disconnected from the piston and was lying at the back end of the cylinder. About 60 per cent of the outer rim of the cup had ruptured and was detached from the central body." Under the rules of this carrier, D-22 type control valves are required to be cleaned at intervals not exceeding 15 months. The air-brake equipment of the car in question was last cleaned and oiled at St. Louis, Mo., 20 months 21 days prior to the day of the accident, the report said, adding that "the components of the material of the packing cup were such that the rupture could have occurred at any time after it was placed in service. The actual time when the rupture occurred is not known."

The maneuvering of the train just prior to the time when the car broke loose was described in the report as follows: "When the train stopped [at the apex of the grade at Gallitzin] the forward part was on the descending portion of the grade and the rear part was on the ascending portion of the grade . . . The stop was made after the engineer of the first engine made a 12-lb. brake-pipe reduction, which was not released until after the first engine was detached. The engineer of the second

Diesel Locomotive Units in Service, Class I Railways, December 31, 1946

	Freight locomotive units		Passenger and combination passenger and freight locomotive units		Total	
Horsepower	No.	Total hp.	No.	Total hp.	No.	Total hp.
3,000	1	3,000	..	......	1	3,000
2,000	5	10,000	485	970,000	490	980,000
1,800	....	......	37	66,600	37	66,600
1,350 or 1,500	1,182	1,612,050	150	213,240	1,332	1,825,290
1,200	....	......	19	22,800	19	22,800
1,000	40	40,000	24	24,000	64	64,000
Less than 1,000	22	10,900	6	3,960	28	14,860
Total road locomotive units	1,250	1,675,950	721	1,300,600	1,971	2,976,550
Switching locomotive units	(Averaging approx. 820 hp. per unit)				2,608	2,137,520
Total road and switching locomotive units					4,579	5,114,070

Note:—530 Diesel locomotive units of 407,510 hp. are estimated to be in service on switching and terminal companies and on Class II and III railroads.

engine encountered difficulty in placing the double-heading cock on his engine in open position. About 2 min. elapsed before he released the train brakes, after which he recharged the brake pipe and then a full-service brake-pipe reduction was made to test the brakes. Then the brakes were released. When the engineer attempted to start the train it was necessary to reverse the engine to close the slack. Then, when a forward movement was started, the brakes became applied in emergency. Immediately afterward it was discovered that the rear car had become separated from the twelfth car. . . ."

The twelfth car was a conventional-type all-steel Pullman, equipped, like the thirteenth, with swivel-shank, A. A. R. Type T tight-lock couplers at each end. The rear coupler of the twelfth car was cast in June, 1943, and the last shop inspection was made at Sunnyside yard, N. Y., on December 20, 1946. Both cars were assembled in the train at Sunnyside about 7 o'clock in the evening before the accident, and the equipment was inspected at Harrisburg and Altoona. The commission's investigation disclosed that the top portion of the rotary lock-lifter of the rear coupler of the twelfth car was broken at the rotor, 1⅝ in. below the point where it rested upon the trunnion.

"Discoloration of the metal of the rotary lock-lifter indicated that the break had existed during a considerable period," the report continued. "It apparently had broken as a result of a severe blow on the gusset section, which was somewhat flattened. An improvised split-key had been inserted in the tell-tale hole of the lift-toggle and, because of the light construction of this key, it had drawn into the lock-block cavity. After the accident the knuckle of the coupler at the west end of the thirteenth car was found in open position, as a result of bent skirting of the car having forced the uncoupling lever to raised position during the derailment. The couplers of both cars were gaged for height, contours and gathering arms, and the measurements were within the required specifications. The anti-creep features of both couplers were in good condition. The lock of the coupler of the thirteenth car could not be raised by the hammer-and-bar method of test. The lock of the rear coupler of the twelfth car could be raised by this test, because of the broken lock-lift lever. . . . Because of the broken lock-lift lever, which nullified the anti-creep features, the slack closures made during the attempt to start the train at Gallitzin resulted in the knuckle lock at the rear of the twelfth car becoming opened."

Shop Improvements

Chicago & North Western.—One of the largest C. & N. W. improvement projects planned for 1947 is the construction of a $1,500,000 Diesel locomotive servicing and repair shop at the road's facilities located at Keeler and Kinzie streets in Chicago, to comprise all facilities for the servicing and repair of the increasing number of Diesels in service on the road.

Miscellaneous Publication

"FINISHES FOR ALUMINUM."—Technical Editorial Service, Reynolds Metals Company, 2500 South Third Street, Louisville 1, Ky. "Finishes for Aluminum," a book in two sections. Nominal price $2. Section One describes some of the properties of aluminum and then details cleaning treatments, mechanical surface finishes, chemical surface finishes, electrolytic oxide finishes, electroplated coatings, paint application methods, paint coatings, special finishes, etc., and concludes with a discussion of the various controls and tests. Section Two, a loose-leaf book, describes in detail materials, equipment, solution preparation, procedure and control for over 30 of the most widely used finishing processes.

Supply Trade Notes

PITTSBURGH PLATE GLASS COMPANY.—*Edward C. Hyland,* director of commercial research-industrial finishes, for the Pittsburgh Plate Glass Company, has retired after 48 years' service with the firm.

◆

STANDARD RAILWAY EQUIPMENT COMPANY.—*W. E. Bikle,* formerly of the San Francisco, Calif., office of the Standard Railway Equipment Company, has been appointed assistant vice-president, eastern territory, with headquarters in New York. *J. H. Schroeder,* formerly of the New York office, has been appointed manager of the San Francisco office.

◆

ALLIS-CHALMERS MANUFACTURING COMPANY.—*A. D. Robertson,* formerly assistant manager of sales and engineering of the Electrical section at the Norwood, Ohio, works of the Allis-Chalmers Manufacturing Company, has been appointed manager of the company's district office at Tampa, Fla., succeeding the late *Berrien Moore.*

◆

MINNEAPOLIS-HONEYWELL REGULATOR CO.—*L. M. Morley* has been elected a vice-president of the Minneapolis-Honeywell Regulator Company, with headquarters at Philadelphia, Pa.

◆

RAYBESTOS-MANHATTAN, INC. — *George W. Marshall, Jr.* has been appointed general sales manager of the asbestos products division of Raybestos-Manhattan, Inc., with headquarters in Chicago. Mr. Marshall will continue as general manager of the asbestos textile and packing division and, in addition, will direct the sales activities of the equipment sales division.

◆

JOSEPH T. RYERSON & SON.—*Park Sanderson* has been appointed manager of the Boston, Mass., plant of Joseph T. Ryerson & Son to succeed *Herbert C. Wills,* who is retiring. *Albert J. Bauer* has been appointed sales representative in the Rocky Mountain states. District sales office headquarters are maintained in the Denver National building, Denver, Colo. *E. F. Wood,* formerly in charge of the Denver office, has been appointed manager of the work order department at the Los Angeles, Calif., steel-service plant.

◆

LANDIS TOOL COMPANY.—*A. J. Jones* has been appointed to the field engineering service department of the Landis Tool Company. Mr. Jones will work in New England through Stedfast & Roulston, Inc., distributors for that territory.

◆

SNAP-ON TOOLS CORPORATION.—Snap-on Tools Corporation of Kenosha, Wis., has opened a branch office at 210 South Poplar street, Charlotte, N. C. *George Weitz,* formerly at the Jacksonville, Fla., branch, will manage the new office.

◆

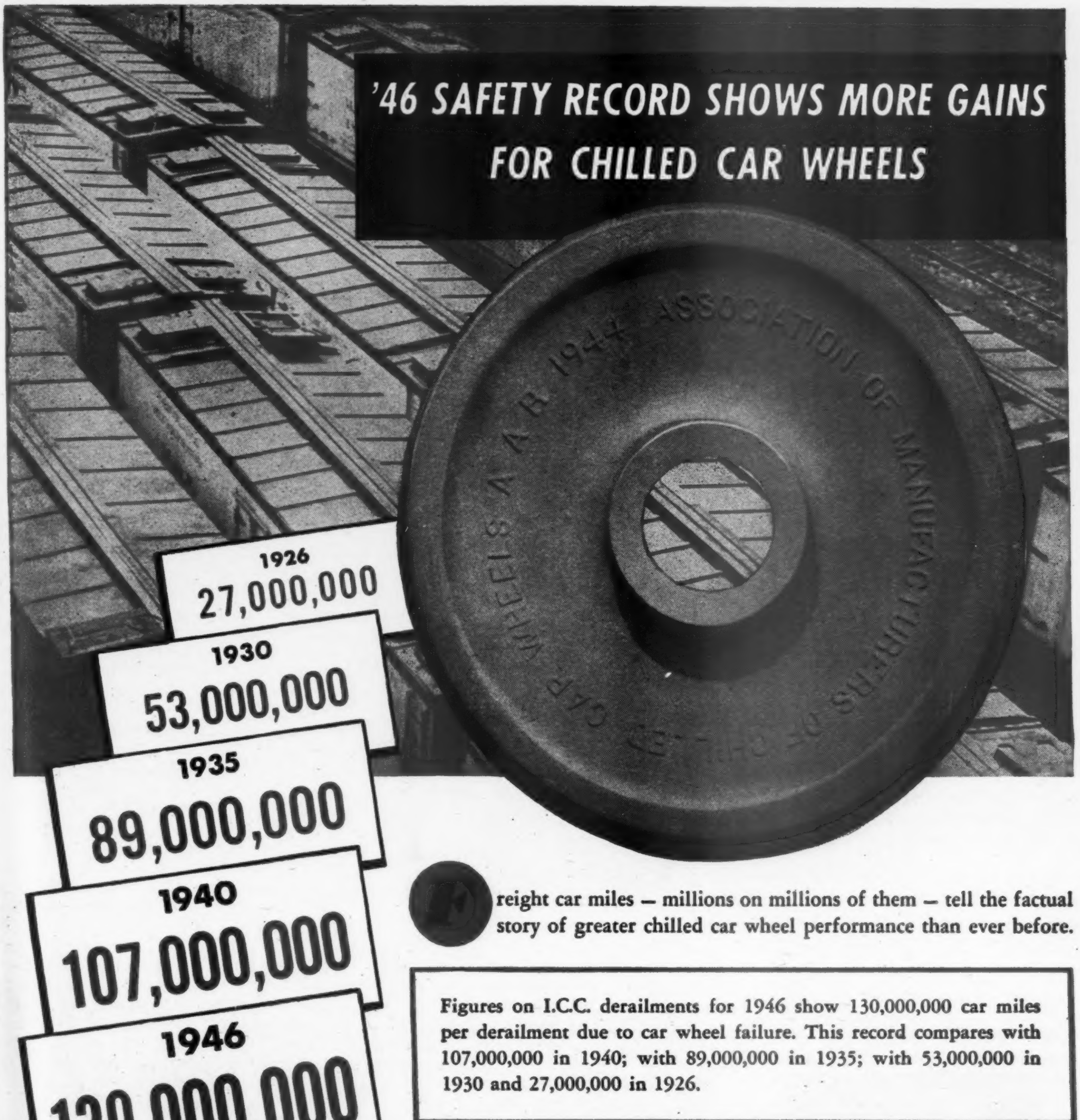
LODGE & SHIPLEY CO.—The Lodge & Shipley Co., Cincinnati, Ohio, has acquired the turret-lathe and hand-screw-machine business of the *Acme Machine Tool Company,* also of Cincinnati, the companies have jointly announced.

◆

NATIONAL MALLEABLE & STEEL CASTINGS CO.—*Stowell C. Wasson,* manager of the National Malleable & Steel Castings Company's two Chicago works at Cicero, Ill., and Melrose Park, has been elected a director to succeed the late Charles H. McCrea. *John R. Kingman,* sales agent at the St. Louis, Mo., office of the National Malleable & Steel Castings Co., has been transferred to the Richmond, Va., office, where he will work exclusively on sales development in the southeastern territory.

◆

WAUKESHA MOTOR COMPANY.—The Waukesha Motor Company has made the following personnel changes in its railway division: *Paul W. Mantz,* formerly supervisor of the parts service department, has been transferred to field sales and service for the northern and eastern accounts, and *Harold Derus,* formerly of the engineering department, has been assigned to field sales and service, covering the southern and western accounts, both with headquarters at Waukesha, Wisc. *William J. Bahr,* formerly assistant supervisor of the parts service department, has been appointed supervisor of that department, and *William Cultice* will coordinate field service activities in addition to his regular duties as laboratory supervisor. *F. A. Fosdal,* former field service supervisor, has resigned to enter business for himself. *M. W. Tietze,* formerly with the Harnischfeger Corporation, has been appointed electrical engineer.



Freight car miles — millions on millions of them — tell the factual story of greater chilled car wheel performance than ever before.

Figures on I.C.C. derailments for 1946 show 130,000,000 car miles per derailment due to car wheel failure. This record compares with 107,000,000 in 1940; with 89,000,000 in 1935; with 53,000,000 in 1930 and 27,000,000 in 1926.

Here's what this means. Even with the increased loads and increased freight speeds of recent years, the relative number of chilled wheel failures last year was approximately only one-fifth of what it was a score of years ago.

What's behind this better safety record? Improvements in design and manufacture. Improvements on the part of AMCCW and the individual initiative of its members. Uninterrupted effort by Association and members alike will be maintained so that even further improvements can be expected in chilled car wheels and the safety records they will achieve in the future.

5061

AMCCW

ASSOCIATION OF MANUFACTURERS OF CHILLED CAR WHEELS
445 NORTH SACRAMENTO BOULEVARD, CHICAGO 12, ILL.

American Car & Foundry Co. • Canadian Car & Foundry Co. • Griffin Wheel Co.
Marshall Car Wheel & Foundry Co. • Maryland Car Wheel Co. • New York Car Wheel Co.
Pullman-Standard Car Mfg. Co. • Southern Wheel (American Brake Shoe Co.)

For additional information, use postcard, pages 51-52

Fairbanks, Morse & Co.—*John F. Marquitz* has been appointed assistant manager of the Railroad Division of Fairbanks, Morse & Co., Chicago. Mr. Marquitz, who succeeds John S. King now manager of the company's Chicago branch, was for several years manager of the company's Seattle, Washington, Branch House. Prior to that he had been with the Dallas, Tex., organization and with the company's Stoker Division.

J. F. Marquitz

◆

Union Asbestos & Rubber Co.—The Union Asbestos & Rubber Co. has acquired all of the capital stock of the Carolina Asbestos Company, which is engaged in the manufacture of asbestos textiles. Carolina Asbestos will continue to operate under the direction of its present management. *C. H. Carlough, president,* and *T. S. Sadler,* vice-president.

◆

Champion Rivet Company.—*Thomas J. Lawless,* formerly sales manager of the Champion Rivet Company, has been elected vice-president in charge of sales.

◆

Hunt-Spiller Manufacturing Corporation.—*F. W. Lampton,* formerly general sales manager, was elected vice-president and general sales manager, and *D. F. Hall,* western sales manager, was elected vice-president and western sales manager at the annual meeting of the Hunt-Spiller Manufacturing Corporation. All other officers of the firm remain the same.

F. W. Lampton

F. W. Lampton began his carrer in 1907 as a machinist apprentice in the employ of the St. Louis-San Francisco at Fort Scott, Kan., and was a machinist from 1912 to 1915 when he became master mechanic of the Arcadia (Kan.) Coal & Mining Co. In 1917 he returned to the St. Louis-San Francisco, serving, successively as night enginehouse foreman at Pittsburg, Kan.; and general foreman at Wichita, Kan.; Thayer, Mo., and at south shops, Springfield, Mo. Mr. Lampton became associated with Hunt-Spiller in 1926 as representative in the southwest territory. He was appointed assistant sales manager in 1941, sales manager in 1942, and general sales manager in 1946.

D. F. Hall served his apprenticeship as a machinist in the Dubuque, Iowa, shops of the Chicago, Milwaukee, St. Paul & Pacific. During World War I he was a member of the air corps and upon returning to the Milwaukee at the end of the war became enginehouse foreman at Ottumwa, Iowa. In 1924, he was appointed sales and service engineer for the Stover Manufacturing & Engine Co., Freeport, Ill. In February, 1928, he became a representative of Hunt-Spiller in the northwestern territory and in June, 1945, was appointed western sales manager.

D. F. Hall

◆

Electro-Motive Division, General Motors Corporation.—*Milton La Riviere* has been appointed regional manager, St. Louis (Mo.) region, of the Electro-Motive Division, General Motors Corporation, succeeding *G. E. Anderson,* who has retired. *Robert E. Hunter* has been appointed district sales manager of the firm's Chicago region.

◆

Standard Stoker Company.—The stockholders of the Standard Stoker Company have approved the merger with the Read Machinery Company, York, Pa., which will be operated as the Read Machinery division. *Charles J. Surdy,* vice-president, export sales, with headquarters at New York, has been appointed vice-president, stoker sales and development; *Joseph B. MacKenzie* has been appointed works manager and chief engineer, and *Elmer F. Seibel* has been appointed mechanical engineer at Standard's Erie, Pa., plant.

National Steel Car Corporation.—*A. P. Shearwood* has been appointed general sales manager of the National Steel Car Corporation of Montreal, Que., and Hamilton, Ont. Mr. Shearwood joined the engineering department of the compnay in 1932 at the Hamilton office. In 1934, he was transferred to the Montreal office and in 1937 was appointed mechanical assistant to the president.

A. P. Shearwood

◆

Rust-Oleum Corporation.—*Walter R. Collins* of *Collins Oil & Manufacturing Co.,* New York, has been appointed a representative of the Rust-Oleum Corporation, to handle certain railroad accounts on the east coast. His headquarters will be at 90 West street, New York.

◆

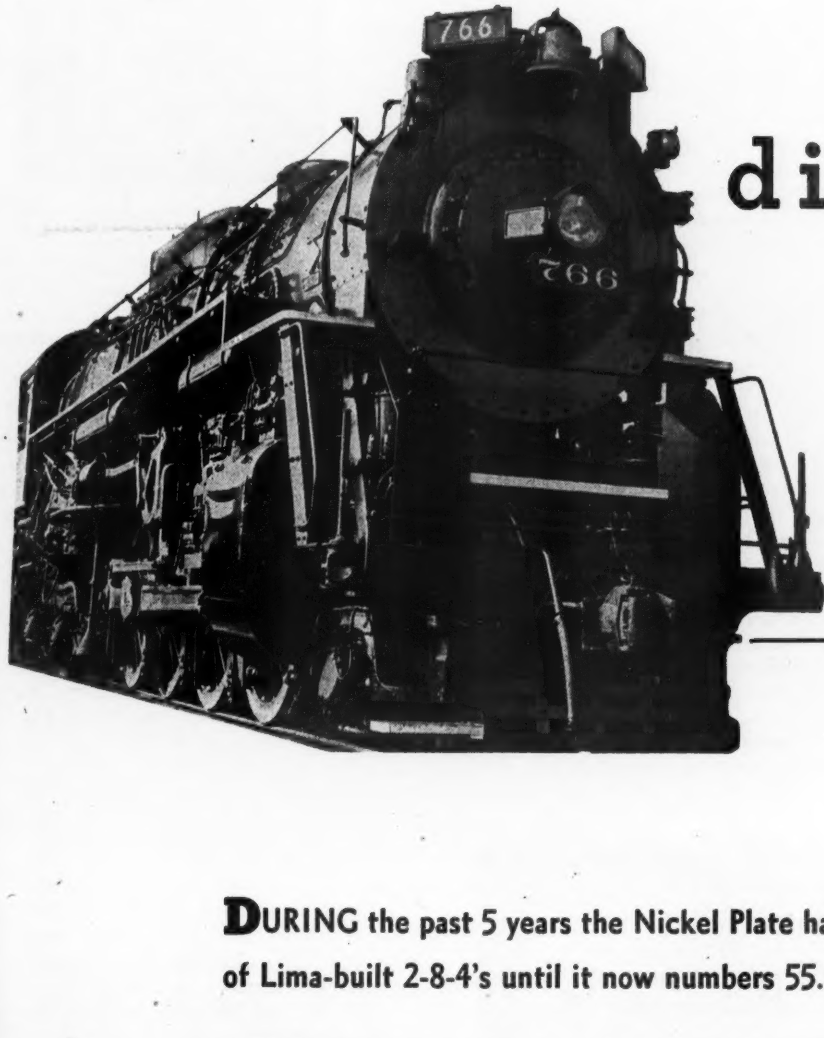
Superheater Company.—*P. D. Blanchard, S. L. Brownlee,* and *L. R. Bryan* have been appointed district representatives in charge of sales and service, and *F. C. Widmayer* special representative of the Superheater Company. All have headquarters at Chicago.

◆

American Welding & Manufacturing Co.—*Edwin E. Van Cleave* has been appointed sales engineer, railway equipment division, of the American Welding & Manufacturing Co., Warren, Ohio. Mr. Van Cleave will handle railroad equipment applications in the Chicago district from headquarters at 332 South Michigan Ave.

Edwin E. Van Cleave

prior planning...



pays dividends

DURING the past 5 years the Nickel Plate has built up its fleet of Lima-built 2-8-4's until it now numbers 55.

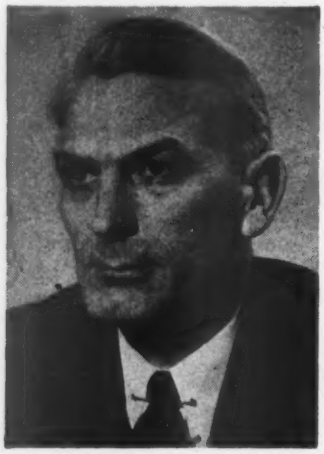
This long term view of traffic problems has enabled this railroad to maintain the necessarily fast schedules required by today's freight demands . . . demands that not only call upon speed but also put a premium on ability to handle maximum payloads at a maximum of efficiency and economy.

LIMA LOCOMOTIVE WORKS LIMA LOCOMOTIVE WORKS INCORPORATED **INCORPORATED, LIMA, OHIO**

For additional information, use postcard, pages 51-52

AMERICAN LOCOMOTIVE CO.—*R. Tom Sawyer* has been appointed manager of the research department of the American Locomotive Company, with headquarters at New York.

R. Tom Sawyer, has been associated with the firm since 1930. Gas-turbine locomotives are a specialty of Mr. Sawyer, who also initiated research on, and the testing of,



R. Tom Sawyer

pulverized-coal-burning pilot plants at Alco's Dunkirk, N. Y., plant. In recent years, he has been active in designing and developing the new line of Diesel-electric locomotives which Alco and the General Electric Company introduced last fall. Before joining Alco, Mr. Sawyer for seven years was engineer on gasoline and Diesel-electric railroad equipment in this country and Australia for General Electric's service and engineering department. He has written "The Modern Gas Turbine" and is co-author of the recently published "Applied Atomic Power."

DAMPNEY COMPANY OF AMERICA.—The Dampney Company of America has appointed the Combustion Equipment & Insulation Co., 1900 Euclid avenue, Cleveland, Ohio, as agent in the Cleveland area for the sale of Apexior and Thur-ma-lox protective coatings.

H. K. PORTER COMPANY.—*Roland E. Nelson* has been appointed manager of the Chicago office of the H. K. Porter Company, to succeed *George L. Green*. Mr. Nelson was formerly sales engineer, serving the St. Louis, Mo., territory.

AIR REDUCTION COMPANY. — *Herman Van Fleet, Jr.*, former assistant to the manager of the New York district, has been appointed manager of the New England district, of the Air Reduction Company, with headquarters in Boston, Mass. Mr. Van Fleet will cover Maine, Vermont, New Hampshire, Massachusetts, Rhode Island and the eastern third of Connecticut. He also will be in charge of the company's plants at Boston, South Portland, Me., and Central Falls, R. I. *Emmett W. MacCorkle, Jr.*, former assistant manager of the gas sales department at New York has been appointed Portland (Ore.) district manager, covering Oregon, the southern half of Idaho and part of Washington in the vicinity of Walla Walla. *L. A. Hamilton* former assistant manager of the Seattle, Wash., district has been appointed as manager of that district which embraces most of Washington, northern Idaho, and Montana.

KENNAMETAL INC. — Kennametal Inc., Latrobe, Pa., has appointed *Lawrence W. Guild*, formerly representative and tool engineer, as manager of the New England district, comprising territories covered by the company's Hartford, Conn., Springfield, Mass., and Boston offices. Mr. Guild's headquarters will be at 1537 Main street, Springfield.

PITTSBURGH PLATE GLASS COMPANY.—The following changes of executive personnel have been made in the merchandising and glass sales divisions of the Pittsburgh Plate Glass Company: *Richard B. Tucker* has been elected executive vice-president. *Donald C. Burnham*, formerly manager of plate glass sales, and *John A. Wilson*, formerly manager of glass manufacturing, have been elected to newly created vice-presidencies. *Wallace R. Harper*, formerly manager of the Boston, Mass., warehouse, has been appointed manager of plate-glass sales to succeed Mr. Burnham, and *William A. Gordon* has been appointed mnager of trade sales. *Marvin W. Marshall*, manager of industrial glass sales, will assume direction of plate and safety glass sales to all production accounts. *Felix T. Hughes*, formerly assistant manager of plate glass sales, has been appointed manager of warehouse sales of plate and safety glass.

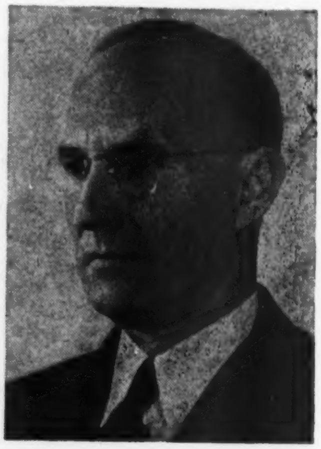
NATHAN MANUFACTURING COMPANY.—*Richard H. Jenkins* has been elected vice-president in charge of sales and *John D Spaulding*, vice-president in charge of production of the Nathan Manufacturing Company.

Richard H. Jenkins received his engineering training at the Virginia Mechanics Institute. He served his apprenticeship in

Richard H. Jenkins

the Southern Railway shops, where he became foreman of the air-brake and boiler appurtenances department in 1909. In 1911 he was appointed assistant mechanical engineer of the Leslie Company, Lyndhurst, N. J. From 1913 until 1918, when he became associated with Nathan he served in various capacities on the Norfolk & Western.

John D. Spaulding received his early training with the Chicago & North Western. After obtaining his mechanical engineering degree from Iowa State College



John D. Spaulding

in 1924, he joined the Collis Company, Clinton, Iowa, where he advanced to the position of superintendent. In 1932 he was appointed works manager of Nathan Manufacturing.

TITEFLEX, INC.—*Melville F. Peters*, formerly in charge of research at Titeflex, Inc., Newark, N. J., has been appointed chief engineer and will continue to direct basic research on Titeflex products. *Gordon J. Wygant*, formerly sales engineer, has been appointed assistant sales manager.

WESTINGHOUSE ELECTRIC CORPORATION.—*Robert A. Neal*, vice-president of the Westinghouse Electric Corporation has been appointed general manager of the company's Pacific coast operations, reporting directly to the president.

CHICAGO RAILROAD SUPPLY COMPANY.—The offices of the Chicago Railroad Supply Company have been moved to 215 West Ohio street, Chicago 10.

EVANS PRODUCTS COMPANY.—*Kenneth J. Tobin* has been appointed a representative of the Evans Products Company, with headquarters at Chicago to promote sales of the railroad loading equipment manufactured by that company's Loading division.

DAYTON MANUFACTURING COMPANY.—*J. L. Franciscus*, 4041 Park avenue, St. Louis, Mo., has been appointed a representative of the Dayton Manufacturing Company, Dayton, Ohio, in the St. Louis and south-central area.

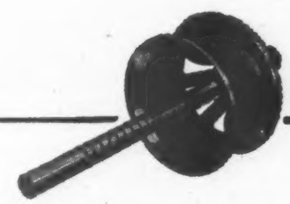
DEARBORN CHEMICAL COMPANY.—*Richard C. Newth*, formerly railroad service engineer of the Dearborn Chemical Company in the New England territory, has been appointed chemical engineer railroad department, with headquarters at Nashville, Tenn.

O. C. DURYEA CORPORATION.—*Victor Robert Weiss* has been elected president of the O. C. Duryea Corporation, succeeding William Bierman deceased. The headquarters of the company will be moved

5 more

WITH THE FRANKLIN SYSTEM OF STEAM DISTRIBUTION AND THE BOOSTER*

for the Chesapeake and Ohio



The five new locomotives ordered by the Chesapeake & Ohio Railway Company from The Baldwin Locomotive Works will be equipped with the Franklin System of Steam Distribution and the Locomotive Booster — as are the five completely modernized locomotives now entering service on this road.

In connection with the first of these rebuilt and streamlined locomotives, TRACKS, Chesapeake and Ohio Lines Magazines, has this to say:

"Principal departure from the mechanical design of the original 490 is the use of a poppet valve system, replacing piston valves. Poppet valves were installed to improve steam distribution, making for greater power and speed, smoother and faster starting, and more efficient and economical operation. The streamlined locomotive also is equipped with . . . a high speed booster to permit a swift, smooth start."

**Trade Mark Reg. U. S. Pat. Off.*

REG. U.S. PAT. OFF.

FRANKLIN RAILWAY SUPPLY COMPANY, INC.

NEW YORK • CHICAGO • MONTREAL

STEAM DISTRIBUTION SYSTEM • BOOSTER • RADIAL BUFFER • COMPENSATOR AND SNUBBER • POWER REVERSE GEARS
AUTOMATIC FIRE DOORS • DRIVING BOX LUBRICATORS • STEAM GRATE SHAKERS • FLEXIBLE JOINTS • CAR CONNECTION

For additional information, use postcard, pages 51-52

[Advertisement]

NEW CLEANING IDEAS

For Further Details Write Magnus

Gummy Dirt in Air Compressors readily responds to cleaning with Magnus Heavy Duty Cleaner. An 8-ounce per gallon solution at boiling will do an excellent job on dismantled compressor parts. No. 101

Keeping Shop Tractors Fit. The cleaning operations involved in the maintenance of shop tractors are all covered in the Magnus textbook on automotive cleaning—the "Magnus Truck & Bus Cleaning Manual." Ask for copies. No. 102

When Bull Rings are Heavily Carbonized, the quickest, easiest method of getting them thoroughly clean without a lot of hand work is to use Magnus 755 in a heated still tank, or, better still, for volume production, in a Magnus Aja-Dip Sr. Cleaning Machine. No. 103

Any Type of Air Filter will be thoroughly cleaned if the Magnusol method is followed. This concentrated emulsifiable solvent is mixed 1 to 8 with mineral oil to make the cleaning solution. No. 104

Small Utility Cleaning Machine Cuts Hand Work

This Magnus Aja-Dip Jr. Cleaning Machine is being used for cleaning automotive carburetors, fuel pumps and other small parts, using Magnus 755.

In railroad work, this efficient cleaning unit should find many useful applications, using #755 or any other specialized Magnus Cleaner called for by the nature of the dirt to be removed. The machine has two compartments, one for cleaning the work, which is moved up and down in the cleaning solution many times a minute, and the other for rinsing. Cleaning time can be cut by as much as 80% by this machine, which also eliminates hand work.

Write for Bulletin 201-AJ for full details.

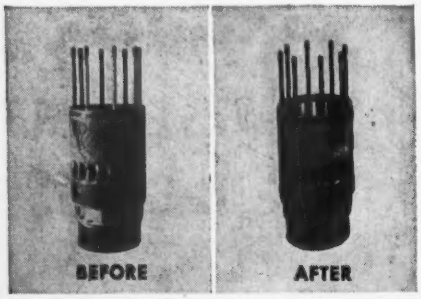
Ending Sludge Troubles in Fuel Oil

Heavy fuel oils naturally tend to build up sludge deposits in storage. But where sludge has been allowed to accumulate, supply pumps begin to pull it up with the oil, and then the trouble begins. Screens clog. Valves are erratic. Burners carbonize. Combustion suffers.

When just a few drops of Magnus Clerex per gallon of oil are added . . . whenever new oil is fed to storage . . . sludge formation is effectively stopped. Moreover, a slightly heavier concentration of Clerex added to badly sludged tanks will disperse the sludge deposits already in existence. Write for the Clerex Bulletin.

50-75% Time and Labor Savings in Cleaning Diesel Parts

Using the combined effectiveness of Magnus 755 and the Magnus Aja-Dip Sr. Cleaning Machine, truly remarkable savings in time and labor are obtainable in the cleaning of diesel parts.



The Aja-Dip Sr. Machine supplies kinetic cleaning action through its principle of moving the work up and down IN the cleaning solution many times a minute. It speeds cleaning remarkably, and helps to eliminate hand work through its mechanical cleaning action. Magnus 755 has been proved by widespread usage to be the most effective carbonized oil remover available today.

This combination is highly successful in cleaning railroad diesel engines and parts.

Reasons for Using a Safe Hand Cleaner

Infections and dermatoses caused by harsh hand cleaners are probably more prevalent in the railroad field than in most industries, because hands get extra dirty, and the temptation is great to use an unsafe cleaner because it works fast. Excessive alkalinity in a cleaner will rob the skin of its natural oils, leading to chapping, cracking and infection. Harsh abrasives in a cleaner will scratch and abrade the skin, again opening the way to infection and irritating cuts and scrapes received on the job.

A safe hand cleaner is only mildly alkaline and contains no sand or similar hard, jagged scouring agents. An ideally safe and effective material for this purpose is Magnus Hand Cleaner. It cleans as fast and as well as any harsh hand soap, but it leaves the skin soft and smooth, with natural oils untouched. Reduced time losses due to infections will be enough to make the furnishing of Magnus Hand Cleaner for the use of employees in all washrooms a very profitable investment.

MAGNUS Railroad Cleaners & Machines

MAGNUS CHEMICAL COMPANY · 77 SOUTH AVE., GARWOOD, N. J.

Service Representatives in Principal Cities

IN CANADA — MAGNUS CHEMICALS, LTD., 4040 RUE MASSON, MONTREAL 36, QUE

from New York to Chicago, but eastern representation will be maintained. Mr. Weiss was formerly with the General American Transportation Corporation for more than 27 years.

◆

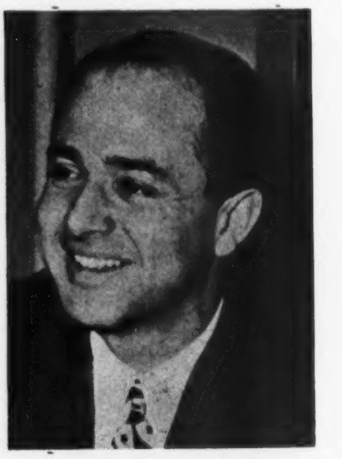
All-State Welding Alloys Company.—The All-State Welding Alloys Company, White Plains, N. Y., has announced the opening of an export office at 21 State street, New York. *J. V. Cremonin* has been appointed manager of the new office.

◆

Jessop Steel Company.—*A. J. Fischer* has been appointed manager of the carbide and cast alloy division of the Jessop Steel Company, Washington, Pa. Mr. Fischer formerly was assistant to the supervisor of carbide production, the Firth-Sterling Steel Company.

◆

Eutectic Welding Alloys Corporation.—*Rene D. Wasserman*, president of the Eutectic Welding Alloys Corporation, who is in charge of research and promotion activities, has announced the appointment of *Albert E. Zeisel* to the position of vice-president in charge of sales. *W. Sigmundis* is now vice-president in charge of production. *T. H. Leston* has been appointed chief engineer of the Corporation's new New York plant.



A. E. Zeisel

Albert E. Zeisel became associated with Eutectic in 1944 as a field engineer for Virginia and the District of Washington. In 1945 he was appointed regional manager of the Mid-Western area, and on January 1, 1946, became assistant to the president in charge of sales, with headquarters in the New York office. Mr. Zeisel, who assumed his position as vice-president in charge of sales on January 1, is a member of the New York Section of the American Welding Society and the St. Louis Missouri Chapter of the American Society of Metals. During World War II he was an associate welding engineer at the New York Navy Yard.

◆

Eaton Manufacturing Company.—*R. H. Daisley* has been elected vice-president and director of manufacturing, with headquarters at Cleveland, Ohio. *H. J. McGinn* has been elected vice-president and director of sales. *E. D. Cowlin,* resident

For additional information, use postcard, pages 51-52

More Locomotive Mileage

through increased availability

• The installation of Security Circulators minimizes honeycombing, flue plugging and cinder cutting, so that, when circulator-equipped, an existing locomotive can operate for longer periods more efficiently.

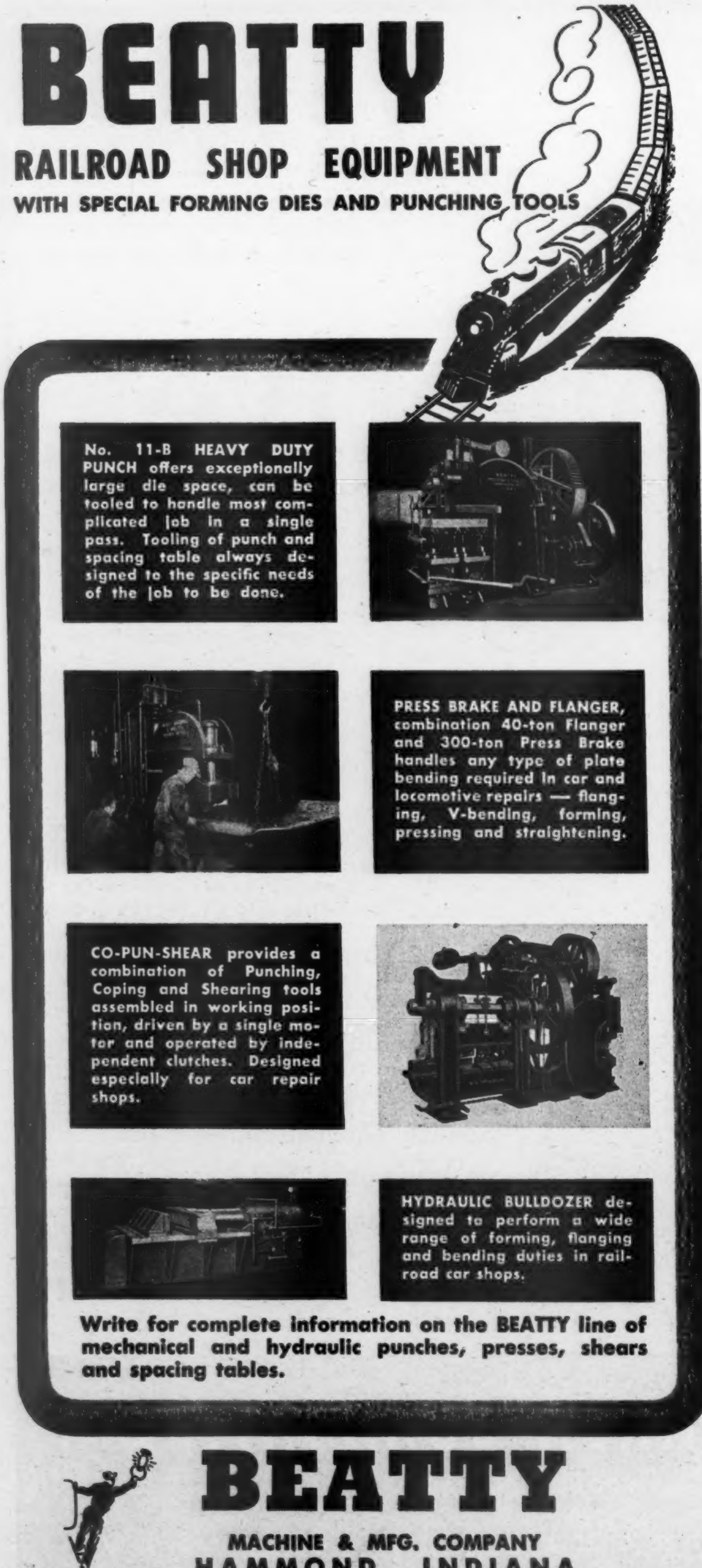
The resulting gain in locomotive availability means that the cost of installing Security Circulators will rapidly be repaid through the increased earning power of the locomotive.

AMERICAN ARCH COMPANY, INC.

NEW YORK • CHICAGO

SECURITY CIRCULATOR DIVISION

For additional information, use postcard, pages 51-52



manager of the Reliance division of the company at Massillon, Ohio, has been appointed manager of the Reliance division, with headquarters at Massillon.

◆

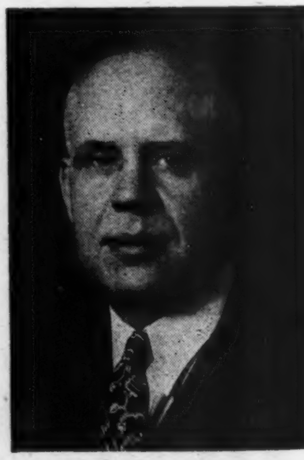
JOHN A. ROEBLING'S SONS COMPANY.—*J. F. Berger* has been appointed assistant sales manager, Woven Wire Fabrics Division, John A. Roebling's Sons Company.

◆

WESTINGHOUSE AIR BRAKE COMPANY.—*C. F. Hammer*, former assistant chief engineer of the Westinghouse Air Brake Company, has been appointed to the newly created position of engineering manager in the engineering department at Wilmerding, Pa. Mr. Hammer entered the employ of the company in 1924 as special apprentice. He was later appointed engineer of tests and in February, 1946, became assistant chief engineer. *W. B. Renshaw* has been appointed central district manager, with headquarters in Wilmerding, where he has served as a representative since 1927. Mr.

C. F. Hammer

Renshaw joined Westinghouse Air Brake in 1913 and previously held positions in the commercial engineering and field organizations of the company. *F. H. Logsdon*,



W. B. Renshaw

former representative in the industrial division of the central district, has been appointed to succeed Mr. Renshaw in the central district.

George L. Cotter, whose appointment as western manager of the Westinghouse Air

For additional information, use postcard, pages 51-52

Powering Baltimore & Ohio's fleet of feature trains, these 22 General Motors Diesel locomotives, ranging from 1,800 to 4,000 horsepower, have met their assigned mileage 96.3% of the time — averaging 19,149 miles a month per unit.

Performance Records on Baltimore & Ohio Railroad

Locomotive Number	Date Delivered	Miles Operated	Miles Assigned	Miles Operated per Month	% Availability
51	*5-37	1,918,127	2,029,654	17,874	94.5
52	*6-37	1,936,349	2,035,562	18,144	95.1
53	1-38	2,013,908	2,106,784	18,647	95.6
54	1-38	1,982,744	2,065.641	18,359	96.0
55	6-38	2,022,246	2,115,802	19,633	95.6
56	6-38	2,043,546	2,131,764	19,840	95.9
57	9-40	1,452,362	1,558,135	19,110	93.2
58	9-40	1,514,170	1,578,446	19,923	95.9
59	9-40	1,541,116	1,590,904	20,278	96.9
60	6-41	1,159,080	1,181,045	17,300	98.1
61	7-41	1,258,725	1,268,358	19,072	99.2
62	7-41	1,382,553	1,402,327	20,948	98.6
63	7-41	1,362,575	1,400,233	20,645	97.3
64	2-45	449,079	473,015	19,525	94.9
66	2-45	453,911	461,455	19,735	98.4
68	9-45	277,478	289,570	17,342	95.8
70	9-45	279,655	283,683	17,478	98.6
72	10-45	288,109	289,901	19,207	99.4
74	10-45	277,856	285,472	18,524	97.3
76	10-45	280,775	284,359	18,718	98.7
78	10-45	324,378	326,170	21,625	99.5
80	10-45	330,887	332,679	22,059	99.5
		24,549,629	25,490,959	423,986	96.3

**Miles assigned figures not available until February 1938, and miles operated, therefore, computed from that date.*

GENERAL MOTORS LOCOMOTIVES

ELECTRO-MOTIVE DIVISION

GENERAL MOTORS **LA GRANGE, ILL.**

"THE ATLANTIC CITY CONVENTION"

after a lapse of ten years
will be held in
Convention Hall, Atlantic City
June 23 to 28, 1947

The members of our Association will display equipment and materials in Convention Hall and at the track exhibit. Many new and advanced ideas will be presented. Railroad officers are cordially invited to attend.

A limited amount of exhibit space is still available.

For particulars address
A. W. Brown, *Secretary-Treasurer*
The Railway Supply Manufacturers Association,
Room 1424, Thirty Church Street, New York 7, N. Y.

GUARD EMPLOYEE HEALTH by installing Ruemelin Fume Collectors wherever welding operations take place. They remove noxious gases, heat and smoke at the source. Eliminate employee fatigue. Speed up welding operations. Especially valuable in winter when doors and windows must be closed. Over one thousand in satisfactory service. Many repeat orders. Write for Bulletin 37-C.

RUEMELIN MANUFACTURING CO.
3982 N. PALMER ST. MILWAUKEE 12, WIS.
Manufacturers and Engineers
PATENTED Sand Blast and Dust Collecting Equipment

RUEMELIN FUME COLLECTOR

Brake Company with headquarters at Chicago, was reported in the April issue, is a graduate of the University of Michigan. He became associated with Westinghouse in 1923 and served in various capacities in the engineering department and in the general

George L. Cotter

office until his appointment in 1929 as district engineer for the Pittsburgh (Pa.) district. In 1940 he was appointed commercial engineer; in 1943, western district manager at Chicago, and in 1945, assistant western manager.

◆

Sharon Steel Corporation. — The Sharon Steel Corporation has been licensed by the Carnegie-Illinois Steel Corporation, a subsidiary of the United States Steel Corporation, to manufacture Cor-Ten steel.

◆

Union Railway Equipment Company. —The Union Railway Equipment Company, at Chicago, has appointed *J. P. Armstrong*, Russ Building, San Francisco, Calif., as representative to handle sales of power hand brakes and refrigerator car devices in the West Coast territory.

Obituary

Rufus N. Hemenway, who retired on January 1 as a vice-president of the Fafnir Bearing Company, died at Daytona Beach, Fla., on February 9. Mr. Hemenway was born in Ludlow, Vt., on February 22, 1872. He joined Fafnir in 1919 and during his first years with the company organized the industrial bearings sales program. Elected as vice-president in 1926, Mr. Hemenway was placed in charge of the sales of Fafnir railroad journal boxes in 1932 in which work he continued until his retirement.

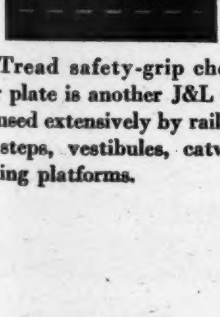
◆

William W. Clouser, chief mechanical engineer of the Buffalo Brake Beam Company, died at his home in Hackensack, N. J., on January 30, after an illness of several months. Mr. Clouser was born on September 26, 1867, in Reading, Pa., where he received his early education. In 1884 he entered the service of the Philadelphia & Reading (now Reading) as a machinist apprentice, studying engineering at night. Four years later he began work in the drafting room, where he subsequently advanced to chief locomotive designer. In 1902, Mr. Clouser came to New York as mechanical engineer on the plans for new

Stretch Your Steel Tonnage 33%

GET MORE UNITS PER TON WITH J&L OTISCOLOY HIGH-TENSILE STEEL

J&L STEEL



Jal-Tread safety-grip checker floor plate is another J&L product used extensively by railroads for steps, vestibules, catwalks, loading platforms.

GAIN AN EXTRA UNIT FOR EVERY THREE

—*Use Otiscoloy*

A 25% reduction in weight of baggage cars and other rolling stock is being accomplished by many car builders. Through use of extra strength of high-tensile steel in side panels, frames and sills they gain one unit for every three formerly produced with ordinary carbon steel. J&L Otiscoloy High-Tensile steel is produced in plates, sheets, angles, Junior Beams, Tees, and Channels. Write today for full information on stretching your steel to produce more units per ton.

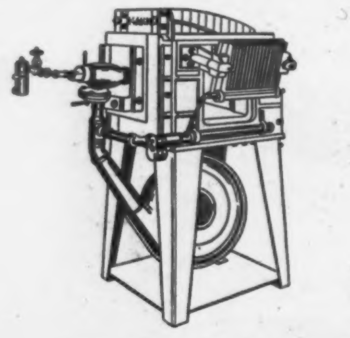
JONES & LAUGHLIN STEEL CORPORATION

PITTSBURGH 30, PA.

For additional information, use postcard, pages 51-52

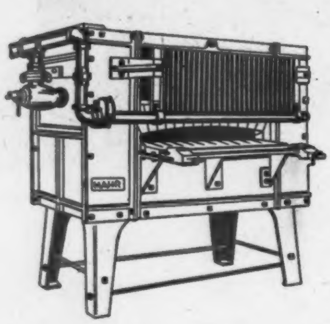
RAILROAD **MAHR** EQUIPMENT
ENGINEERS • DESIGNERS • MANUFACTURERS
ALL EQUIPMENT FOR METAL HEATING

BUILT BY SPECIALISTS in railroad equipment for 33 years, MAHR forges, torches, furnaces, burners, blowers, valves and similar equipment are dependable, safe, efficient and economical.



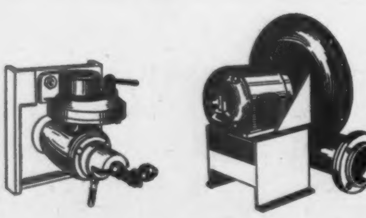
MAHR NO. 35 RIVET HEATER & FORGE

This combination Rivet Heater and Forge handles 800 ¾" x 3" rivets or 100 to 125 lbs. of small parts per hour. With opening 12" x 5" and heating chamber 17½" x 13½", this unit is very popular for forming or forging, and heating of small bars, upsetting and the like. May be equipped with gas or oil burner and low pressure combustion air blower. Other models also available for use on compressed air.



MAHR MODEL "CA" SLOT TYPE FORGE

Ruggedly constructed with a heavy cast iron frame, this forge is built for long, hard service. Ideal for heating bar stock of larger diameters. Slot opening up to 5" high, as wide as 48". Water cooled shield, air curtain and adjustable stock rest. Available with single opening as shown, with double front opening, or with opening both front and back. Gas or oil fired.



MAHR BURNERS AND BLOWERS

MAHR oil or gas burners supply a steady flow of intense heat. Start quickly, easily . . . adjust instantly . . . remain constant as set . . . burn in bright, sharp, clean flame. Available in low pressure and compressed air models. MAHR Centrifugal Blowers are designed for maximum efficiency, economy and performance. 9 standard sizes; 16 discharge positions. Individual MAHR Blowers cost less than central blower system . . . save up to 50% on power costs . . . deliver constant air pressure.

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and improved equipment for the Vanderbilt developments. The following year he joined Buffalo Brake Beam where he devoted himself continuously for 44 years to the improvement of freight-car brake beams.

◆

W. Eckels, sales representative of the Cardwell Westinghouse Company at Chicago, died suddenly in Cleveland, Ohio, on March 15.

◆

Leonard L. Solger, who had been in charge of railway sales since 1925 for the Republic Steel Corporation at Chicago, died at St. Joseph's Mercy hospital in Aurora, Ill., on March 3.

◆

Edwin W. Newcomb, Pacific coast sales manager for the primary battery division of Thomas A. Edison, Inc., Bloomfield, N. J., died at Oakland, Calif., on March 22 after a long illness. Mr. Newcomb was 76 years old.

◆

Harold H. Horn, western general sales manager of the Pantasote Corporation of New Jersey, with headquarters at Chicago, died suddenly at his home on March 15.

◆

Robert W. Schulze, western representative of the Cardwell Westinghouse Company, with headquarters at Chicago, died at Santa Ana, Cal., on March 3, following a lengthy illness.

◆

George A. Hull, vice-president and a director of the Union Asbestos & Rubber Company, died at his home in Vista, Calif., on April 5, following a short illness.

◆

Phillip Tarasi, a member of the railroad sales department of the Chicago Pneumatic Tool Company, died on March 4, after a short illness. He was 57 years old.

◆

M. C. M. Hatch died at his home at Provincetown, Mass., on April 5, after a long illness. Mr. Hatch was born at Chelsea, Mass., March 14, 1882, and after attending Massachusetts Institute of Technology and the University of California entered the service of the Southern Pacific at West Oakland, Calif., shops in June, 1903. He worked also in the testing and signal departments. He then went to the Needles, Calif., and the San Bernardino shops of the Atchison, Topeka & Santa Fe. In June, 1905, he became a draftsman in the motive power department of the Boston & Maine; December, 1906, chief draftsman and engineer of tests of the New England Lines in November, 1911. In June, 1912, he was appointed superintendent of fuel service of the Delaware, Lackawanna & Western. In February, 1917, Mr. Hatch resigned to become assistant to the president of the Locomotive Pulverized Fuel Company. Later he became associated with the Railway & Industrial Engineers. He reentered railway service in 1921 as assistant mechanical engineer of the Missouri-Kansas-Texas, but was soon promoted to mechanical engineer, then to assistant to the executive vice-president, and in March, 1924, to general mechanical superintendent. After retiring from that position in 1925 he was associated with the Armspear Man-

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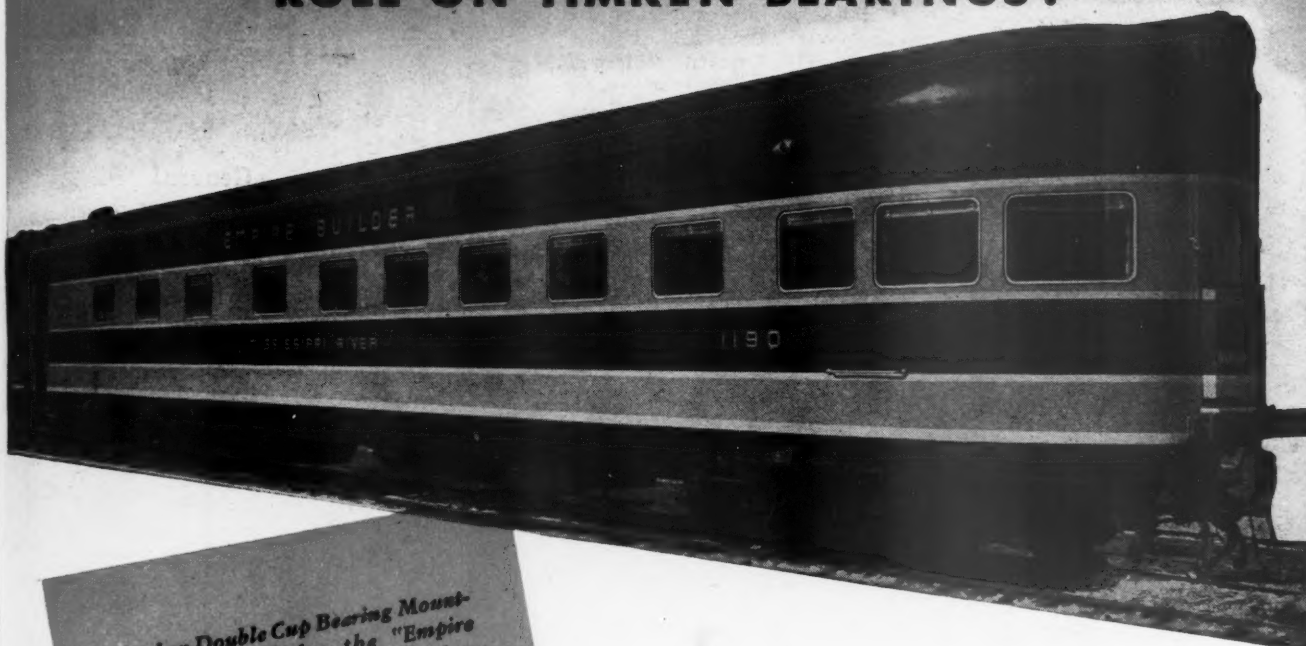
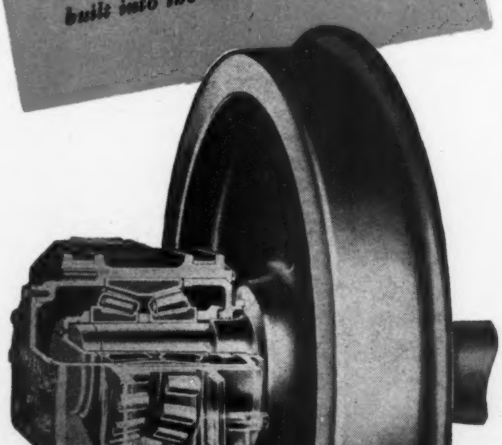


Timken Double Cup Bearing Mounting as used under the "Empire Builder" cars. This assembly does not require adjustment at time of installation, the adjustment being built into the bearing at the factory.



All 60 cars of the five 12-car ultra-modern streamlined all-accommodation trains comprising the Great Northern Railroad's new "Empire Builder" service are equipped with Timken Roller Bearings. These trains now are in daily operation on a 45-hour schedule between Chicago, the Twin Cities and Pacific Northwest.

Four of the trains were purchased by the Great Northern and one by Burlington Lines. Operation of all five is Burlington between Chicago and St. Paul and Great Northern between St. Paul and Seattle.

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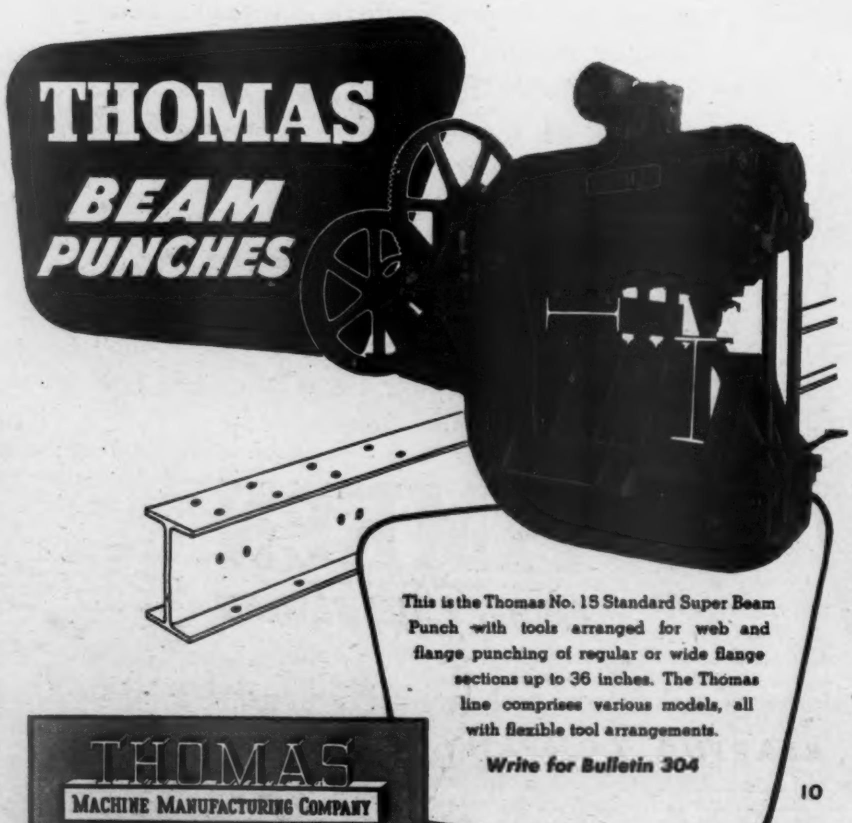
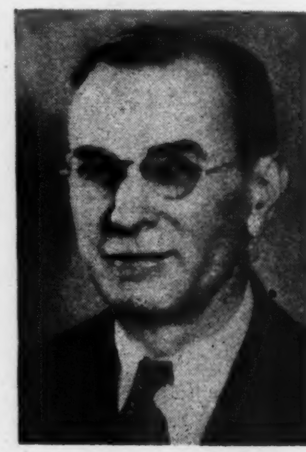


ufacturing Company of New York, and later was a representative of the Standard Stoker Company at Boston, Mass. Illness forced him to retire a number of years ago, since which time he has been living on Cape Cod and giving time, so far as his health would permit, to the study of American steam locomotive development. He only recently completed the manuscript for a book on this subject, tentatively entitled, "White Feather and Red Stack."

Personal Mention

General

FRANK ZELENY, engineer of tests of the Chicago, Burlington & Quincy at Aurora, Ill., has retired. Mr. Zeleny was born at Hutchinson, Minn., on December 5, 1876. After completing his high-school work in 1894 at East Minneapolis High School, he entered the University of Minnesota, of



F. Zeleny

which he is a graduate in mechanical engineering (1898). While at the University he specialized in railway mechanical engineering and upon graduation he entered the service of the Burlington as a special apprentice. In 1902 he became mechanical draftsman at the locomotive and car shops at Aurora; in 1906, assistant superintendent of shops, and in 1912, engineer of tests. Mr. Zeleny was active on specifications and other committees of the American Society for Testing Materials and of the Association of American Railroads. For several years he was chairman of the A.A.R. Committees on Tank Cars.

G. J. LEHNERER, mechanical engineer of the Illinois Central, has been appointed assistant to the general superintendent of equipment, with headquarters at Chicago.

A. E. RICE, assistant to chief mechanical officer of the Denver & Rio Grande Western, at Denver, Colo., has been appointed assistant chief mechanical officer, with headquarters at Denver.

W. C. BOWRA, superintendent of motive power and car equipment of the Canadian National, at Montreal, Que., has been ap

For additional information, use postcard, pages 51-52

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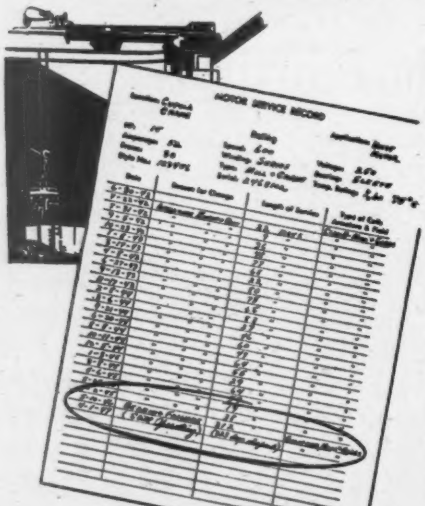
by GREAT NORTHERN'S Dependable Freight Operations

Silicone News

DC

DC Silicone Insulation CUTS MOTOR FAILURE 90%!



SERVICE RECORD COURTESY NATIONAL ELECTRIC COIL CO.

A cupola crane motor used to unload scrap in a large steel mill was designed for intermittent service. But steel hungry America kept it working full time to meet war and postwar requirements. Insulated with the best Class 'B' materials, this motor failed 22 times in about three years, giving an average service life of only 50 days.

Design limitations made it impossible to install a larger motor. Lost time, costly rewinding, and heavy maintenance expense seemed inescapable—until DC Silicone Insulation was introduced by Dow Corning.

National Electric Coil Co., of Columbus, Ohio, was one of the first to realize the advantages of Silicone-glass-mica insulation. Their engineers redesigned the coils of that motor using Silicone Insulation—DC 996 Varnish with glass and mica.

Then it operated almost continuously for 312 days—six times the average life with Class 'B' insulation—before a bearing failed, causing mechanical failure of the insulation. The motor was again rewound with Silicone Insulation and was still running April 1, 1947—after 323 days!

DC Silicone Insulation will keep hard-working motors running at least 10 times as long as Class 'B' insulation. That's proved by three years of tough tests and field service. DC 996 is further described in leaflet No. W 3-7.

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FIRST IN SILICONES

pointed general superintendent of motive power and car equipment of the Grand Trunk Western (part of the C. N. System), with headquarters at Battle Creek, Mich.

C. B. Smith, engineer of tests of the Boston & Maine and Maine Central at Billerica, Mass., has retired after 52 years of continuous service with those roads.

W. S. Davis, superintendent of motive power and car equipment of the Northern Ontario district of the Canadian National at North Bay, Ont., has been transferred to the position of superintendent of power and car equipment, Montreal district at Montreal, Que.

Hugh B. Main, director of research of the Canadian Pacific Air Lines (a subsidiary of the Canadian Pacific), has been appointed assistant to the president, with headquarters at Winnipeg, Man.

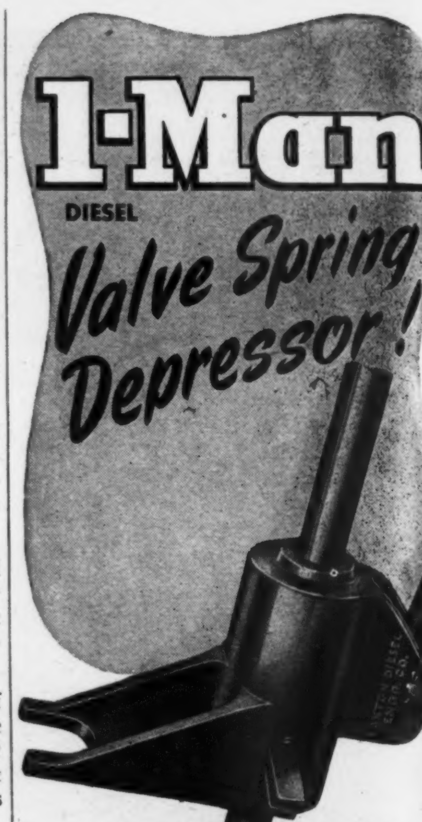
G. L. Galloway has been appointed superintendent of motive power and car equipment of the Northern Ontario district of the Canadian National, with headquarters at North Bay, Ont.

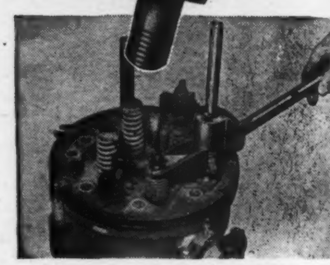
W. H. Clegg, general superintendent of motive power and car equipment of the Grand Trunk Western (a part of the Canadian National System) at Battle Creek, Mich., has retired after 35 years of service with the road.

James W. McLaughlin has been appointed assistant vice-president in charge of car department of the Southern Pacific of Mexico, with headquarters at Guadalajara, Jalisco. Mr. McLaughlin was born on April 10, 1917, at Alamosa, Colo. He entered railway service with the Denver & Rio Grande Western in 1936 as a carbuilder apprentice, and later held positions as mechanic and car foreman with the Rio Grande, and as car builder technician with the U. S. Railway Mission in Mexico. In 1945 he returned to the D. & R. G. W. as general car foreman, the position from which he resigned to become assistant vice-president of the Southern Pacific of Mexico.

James W. McLaughlin

Elliot E. Schlottman, trainmaster of the Illinois Central at Jackson, Mich., has been appointed superintendent at Vicksburg, Miss., Mr. Schlottman was born on March 24, 1903, at Vicksburg, and attended St. Aloysius College in that city. He





Single compact unit. Models available for most types of engines.

Save up to 50% in time and labor on dismantling and assembling Diesel engine valves by equipping your service shops with this new service tool.

Compresses valve spring to any point — *holds it there.* Safe and easy to apply. Makes valve dismantling and assembly quick, safe, easy.

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STANDARD ENGINEERS NOTEBOOK

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Calol Pressure Gun Grease is especially made to withstand continuous shocks on bearings without squeezing or rubbing off. A special stringiness agent and heavy-bodied oil added to its water-resistant-type soap body provides this quality and maintains a tough lubricant film.

It feeds slowly from reservoirs to bearings, assuring thorough lubrication throughout maximum service periods.

There is a special grade of Calol Pressure Gun Grease, "Summer", for unusually severe service.

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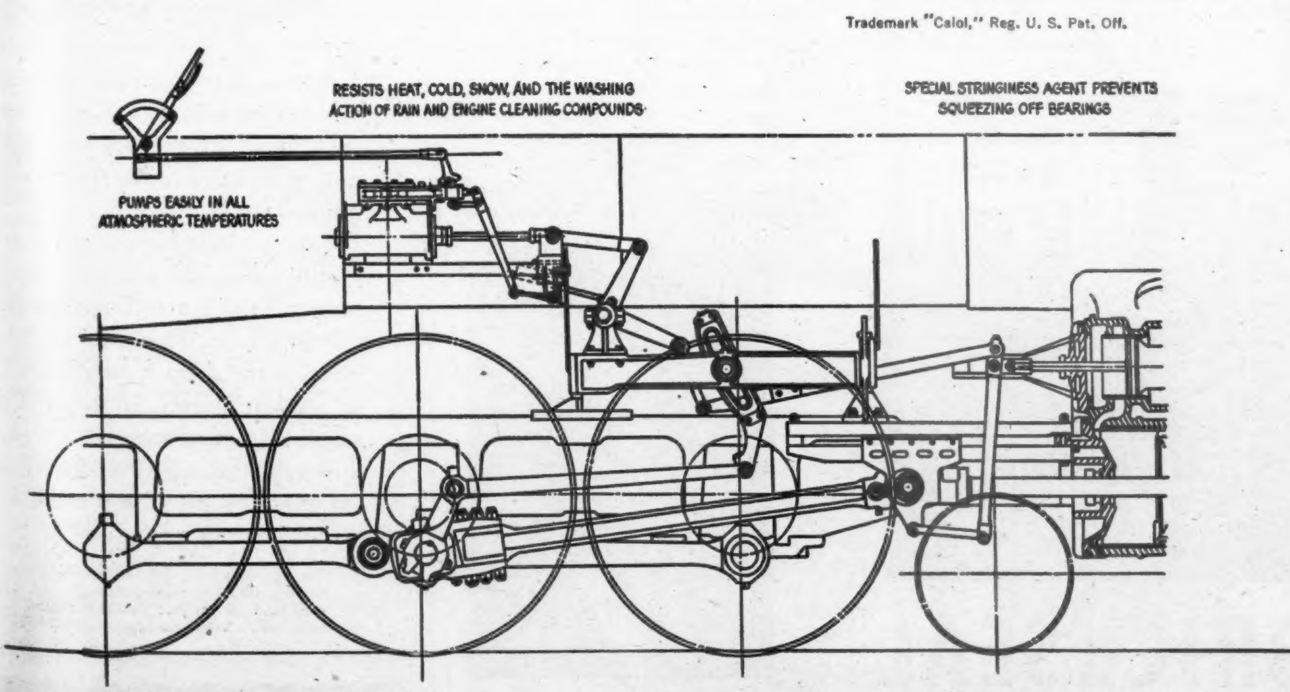

For additional information and the name of your nearest Distributor, write Standard of California, 225 Bush Street, San Francisco 20, Calif.; The California Oil Company, 30 Rockefeller Plaza, New York 20, N. Y.; The California Company, 17th and Stout Streets, Denver 1, Colo.; Standard Oil Company of Texas, El Paso, Texas.

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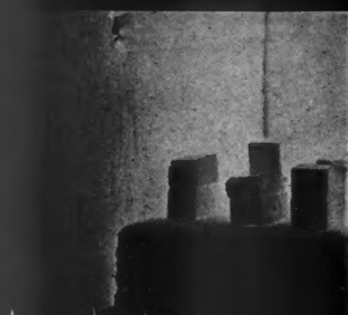

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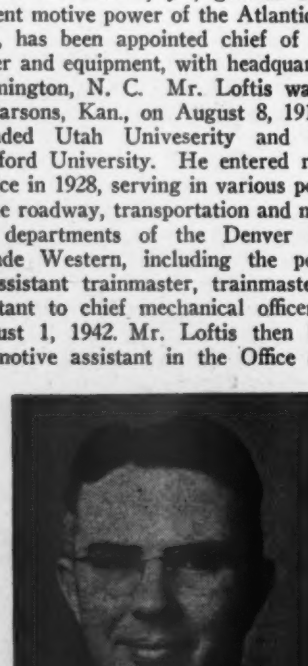
Elliot E. Schlottman

entered railway service with the I. C. in 1919 as a machinist apprentice at Vicksburg and subsequently became machinist; foreman, locomotive and car department, Natchez, Miss.; foreman, Shreveport, La.; day enginehouse foreman, McComb, Miss.; general foreman at Asylum, Miss., and general foreman at McComb. In 1940 he was appointed trainmaster at Hattiesburg, Miss., holding that position successively also at Jackson, Miss., and Jackson, Tenn.

K. F. McCall has been appointed assistant engineer of tests of the Boston & Maine and Maine Central.

John D. Loftis, Jr., general superintendent motive power of the Atlantic Coast Line, has been appointed chief of motive power and equipment, with headquarters at Wilmington, N. C. Mr. Loftis was born at Parsons, Kan., on August 8, 1911, and attended Utah Univeserity and Leland Stanford University. He entered railroad service in 1928, serving in various positions in the roadway, transportation and mechanical departments of the Denver & Rio Grande Western, including the positions of assistant trainmaster, trainmaster, and assistant to chief mechanical officer, until August 1, 1942. Mr. Loftis then became locomotive assistant in the Office of De-



John D. Loftis, Jr.

fense Transportation. He was subsequently mechanical assistant and assistant to director, Division of Railway Transport and chief, Traffic Flow Unit. On Decem-

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ber 16, 1943, he became manager of the Cleveland suboffice of the Baldwin Locomotive Works, and on August 1, 1944, became district manager, sales, service and engineering of the Eastern district sales territory at Philadelphia, Pa. On October 1, 1945, Mr. Loftis was appointed general superintendent motive power of the Atlantic Coast Line at Wilmington.

Diesel

T. A. Stewart, assistant supervisor of Diesel engines of the Atchison, Topeka & Santa Fe at Chicago, has been transferred to the position of assistant supervisor of Diesel engines to Los Angeles, Calif.

Harold F. Mackey, assistant supervisor of Diesel engines of the Atchison, Topeka & Santa Fe, with headquarters at Los Angeles, Calif., has been promoted to supervisor of Diesel engines at Chicago.

V. C. Golden, special assistant to the general manager of the Chicago, Indianapolis & Louisville, at Lafayette, Ind., has been appointed superintendent of Diesel locomotive maintenance and operation, with headquarters at Lafayette.

Electrical

Edgar Mawhinnie, has been appointed supervisor of electrical maintenance of the Chicago terminal of the Illinois Central.

M. J. Clark, supervisor of electrical maintenance of the Chicago terminal of the Illinois Central, has retired after 48 years of railroad service.

R. M. Toning, assistant electrical foreman of the Beech Grove shops of the New York Central, has been appointed electrical engineer of the Atlantic Coast Line.

Master Mechanics and Road Foremen

J. L. Harvey, master mechanic of the Cambria & Indiana at Colver, Pa., has retired, at his own request, because of ill health, after 10 years of service.

M. H. Kline has been appointed master mechanic of the Cambria & Indiana, with headquarters at Colver, Pa.

R. V. K. Jennings, division master mechanic of the New York, New Haven & Hartford at Hartford, Conn., has been transferred to the position of division master mechanic at Boston, Mass.

Geo. Higgins has been appointed division master mechanic of the New York, New Haven & Hartford, with headquarters at Providence, R. I.

H. V. Gill, master mechanic of the Atchison, Topeka & Santa Fe, at Winslow, Ariz., has been transferred to Barstow, Calif. The office of the master mechanic of the Arizona division has been moved to Barstow.

T. T. Blickle, who has been appointed master mechanic, Western division of the Atchison, Topeka & Santa Fe, with headquarters at Dodge City, Kans., as announced in the April issue, was born on November 12, 1909, at Rochester, Minn. He received his education in high school and through International Correspondence Schools steam electrical and Diesel engineer courses. He entered the service of the Santa Fe on July 30, 1927, as a shop apprentice at Fort Madison, Iowa. He completed his apprenticeship as a machinist in 1931 and then worked as a stationary fireman and stationary engineer at Chicago until 1936 when he was transferred as a machinist to the

T. T. Blickle

Eighteenth street (Chicago) Diesel shops. He became a Diesel maintainer at Chicago six months later; assistant supervisor of Diesel engines in 1941; supervisor of Diesel engines at Chicago in July, 1942, and master mechanic at Dodge City on March 1, 1947.

John L. Christian, master mechanic of the Kentucky & Indiana Terminal at Louisville, Ky., has been tranferred to the position of master mechanic at Meridian, Miss.

J. E. Wightman, assistant to works manager of the Pennsylvania at Altoona, Pa., has been appointed acting master mechanic, Indianapolis and St. Louis divisions, with headquarters at Indianapolis, Ind.

Robert W. Hooper, assistant master mechanic of the New York, New Haven & Hartford at New Haven, has been transferred to the position of division master mechanic at Hartford, Conn.

Karl A. Lentz, master mechanic of the Southern system at Meridian, Miss., has been tranferred to Birmingham, Ala.

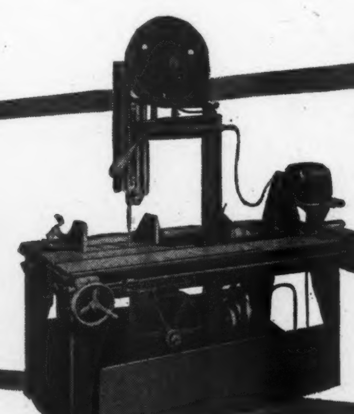
Wilson A. Edmonds has been appointed road foreman of engines of the Southern, with headquarters at Columbia, S. C.

C. W. Booth, division master mechanic of the New York, New Haven & Hartford at Providence, R. I., has retired.

H. W. Maxwell, division master mechanic of the New York, New Haven & Hartford at Boston, Mass., has retired.

Obituary

Herbert A. Stewart, who retired in 1939 as general mechanical inspector of the Fruit Growers Express at Alexandria, Va., died on April 3 at his home in that city, after a long illness. He was 75 years old.



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The number 8 MARVEL saw will handle the smallest, as well as the largest work up to 18" x 18". It will cut-off, trim, miter, notch, and split all bar stock, pipe, structural sections, moulding, tubing, or irregular shapes.

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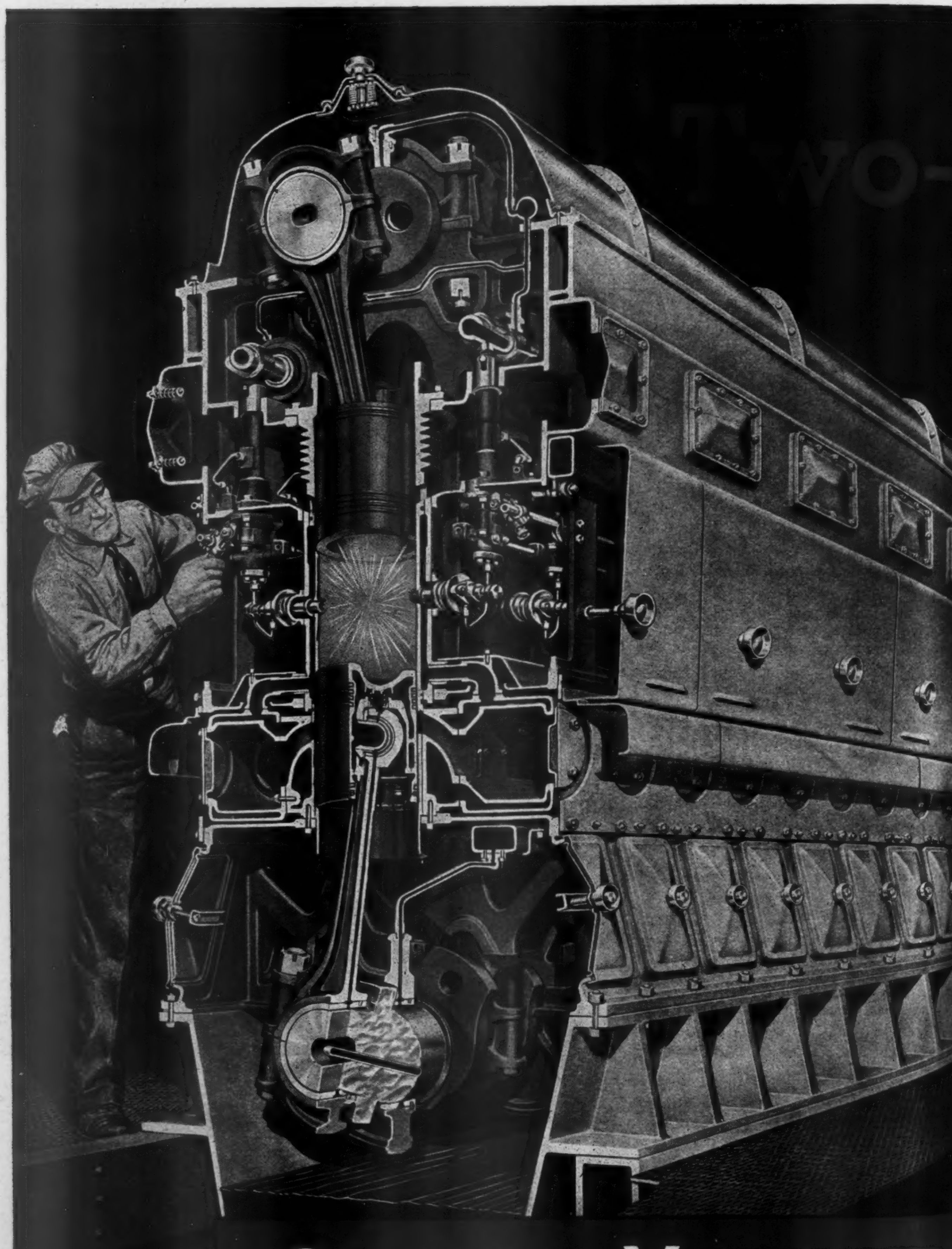

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